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PRESERVATION OF LEATHER BOOKBINDINGS.

By R. W. FREY AND F. P. VEITCH.

Millions of leather bindings in public and private libraries of this country are in various stages of decay. Some may show little, if any, sign of decay; others can be scratched easily and have worn corners and slight cracks. Many are badly scuffed, powdery, and dusty, and are broken through along the hinges. They must be rebound to be serviceable. Frequent re-binding because of rapid deterioration is an item of great cost to libraries and to owners of books.

A long life is expected of leather bindings and this expectation should be realized if the leather is properly tanned and the bindings properly cared for. Of the several causes that contribute to the rotting of leather bindings, one almost invariably is lack of sufficient oil or grease in the leather. The timely application of dressings containing suitable oils and greases will add many years to the service of a leather binding. Such dressings lubricate the fibers, thus imparting flexibility and strength to the leather. They also protect the fibers by rendering them less absorptive and more impervious to the harmful gases that usually are in the air.

It is not possible with dressings or other treatments to restore, in the strict sense of the word, the original good properties, life, or fibre of a piece of rotted leather. Treatment should be started when the bindings are new and should be repeated periodically, once every year or two. When treatment is postponed, as is so often the case, until the leather shows signs of decay, it is too late to preserve the binding in prime condition. Even at this stage, however,

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treatment will retard further rotting and so prolong the life of the binding.

Quick, direct, and positive tests of the efficiency of different dressings and materials in preserving leather are not possible because of the relatively long time that *is required for the natural aging and* deterioration of the leather. On basis of experience and of existing knowledge about the effect of various oils and greases on leather many dressings for the preservation of leather have been compounded from time to time. Among those that have appeared good are the preparations tabulated below.

Preparation 6 was developed by the New York Public Library and has been used systematically by that institution for several years. It is easily prepared and applied and gives good results.

Preparation 7, or purified vaseline, has been used during the past 20 years by the Worcester County Law Library, Worcester, Mass.

It is important that the materials used to make the preparations be of the best quality and practically pure.

These dressings are not difficult to make, but if so desired, arrangements probably can be made with a local pharmacist or commercial chemist to prepare them. All the formulæ are expressed in per cent. by weight.

Preparation 1.

Neat's-foot oil, pure, 20° C cold test	25.0
Lanolin, anhydrous	17.5
Japan wax, pure	10.0
Sodium stearate, powdered	2.5
Water, *distilled*	45.0

Preparation 2.

Lanolin, anhydrous	30.0
Castor oil	12.0
Japan wax, pure	5.0
Sodium stearate, powdered	3.0
Water, distilled	50.0

Preparation 3.

Lanolin, anhydrous	50.0
Neat's-foot oil, pure, 20° C. cold test	35.0
Japan wax, pure	10.0
Sodium stearate, powdered	5.0

Preparation 4.

Lanolin, anhydrous	55.0
Sperm oil, winter strained	25.0
Japan wax, pure	15.0
Sodium stearate, powdered	5.0

Preparation 5.

Neat's-foot oil, pure, 20° C. cold test	50.0
Castor oil	50.0

Preparation 6.

Lanolin, anhydrous	40.0
Neat's-foot oil, pure, 20° C. cold test	60.0

Preparation 7.

Petrolatum or petroleum jelly	

When making the preparations the ingredients should be melted or dissolved by heating them on a steam bath or in a double boiler. Scorching or burning is *likely to result from heating directly over* a flame.

Preparations 1 and 2 are emulsions with water and can be made in the same way. Melt together in one container all the ingredients except the sodium stearate and distilled water. Mix the sodium stearate and that water in another container. Cover this container, and heat slowly and gently until the stearate is dissolved. The pour the sodium stearate solution in a thin stream into the melted grease while stirring it vigorously. A thin milklike mixture will result. Let this cool. When the mixture is about cold it will be noticeably stiffer and from this stage on it should be constantly and thoroughly stirred until uniform in appearance. If properly made, these dressings will be very smooth, ointmentlike, nearly white to pale-cream preparations without any separation of water. If the emulsion separates into two layers, it can be restored by vigorously stirring or whipping the mixture when it is cold. These preparations should always be kept in a container with a tight-fitting cover to prevent evaporation of water and consequent drying and hardening. Glass screw-cap jars, such as are used frequently for vaseline, ointments, and cold creams, make convenient receptacles.

Preparations 3 and 4 are made by heating the specified ingredients together in one vessel until all but the sodium and stearate powder have melted. The mixture is then poured on a smooth, nonabsorbing surface, such as a piece of plate glass or a marble stone, or glass topped table, and worked with a spatula as it cools. The small white particles of sodium stearate are "rubbed in" with the spatula and thoroughly worked into the other ingredients until a salvelike mixture, perfectly uniform in appearance, and without any lumps or white specks, is obtained. It is essential to work in the sodium stearate as described.

Preparation 5 is simply a mixture of equal quantities of neat's-foot oil and castor oil.

Preparation 6 is a soft salve. To make it, warm the lanolin slowly until it is melted, thenadd the neat's-foot oil, stir thoroughly until the mixture is uniform, and let it cool.

Preparation 7 is simply purified petroleum jelly or vaseline.

APPLICATION OF DRESSINGS.

At the outset it should be realized that any oil or grease will darken to some extent law, tan, and other light-coloured leathers and may slightly dull the finish even though the colour be black. This will happen even with colourless or snow-white dressings because the leather absorbs more light after being oiled.

Good judgment should be used in applying oils, grease, or dressings to leather bindings. Care should be taken not to put on so much that the leather will remain greasy to the touch, yet enough should be applied to oil the leather well. Only a thin film of the dressing should be applied at a time. Repeated applications of small quantities should be made until the leather is well oiled. Intervals of several hours should elapse between applications to enable the leather to absorb the oil or grease. The back and hinges of a binding usually rot more rapidly than the sides, and consequently more oil and grease should be applied to these parts. This should be done especially when treating bindings that are already beginning to show decay. In order to increase the rapidity with which leather absorbs oils and greases, as well as the actual quantity it can absorb without remaining greasy, bindings should be put in a warm, but never a hot, place for an hour or two after oiling. The temperature should be about 100° to 115° F.

Dressings are best applied with the fingers and palm of the hand. Use a firm, rapid stroke and spread the dressing over as much of the leather at one time as is feasible, in order to distribute the oil and grease uniformly. The dressing should be rubbed well into the leather and not merely smeared on it. It is the oil that gets into the leather, and not simply on it, that counts. If it is not desired to use the hand, a small swab of cheesecloth, chamois, felt, or other suitable material may be employed.

The New York Public Library recommends that their preparation be applied by means of a flat varnish bruch of appropriate size. Take care to apply the dressing only to the leather. After treatment let the binding stand for a few hours, or overnight, until the oil is absorbed. Then polish with a soft cloth. If an added polish is desired, apply a small quantity of castor oil with a soft cloth and polish with a chamois or sheep's-wool polisher.

As a rule, the smoother, harder, and more shiny the finish of the leather, the less oil and grease it will take up without becoming greasy. Sheepskin bindings will usually absorb the most oil and will be most discoloured, and Morocco or other goatskin bindings the least. Cowhide and calfskin bindings are intermediate in this respect.

Dry, porous bindings that show a tendency to peel or to be powdery are almost impossible to oil uniformly. Leather in this condition is very absorbent and literally grabs the oil as soon as contact is made with it. After such bindings are oiled, areas of the leather having unequal depth of colour are almost inevitable, and the middle part of the back between the hinges will be darker than the leather on each side unless the bindings was originally very dark or black.

In dressing bindings in such a condition and indeed all very absorbent bindings, a more even distribution of oil probably can be obtained with preparations 1 and 2 because they are about one-half water. Bindings in a relatively sound condition, that is, with the grain of the leather intact and not powdery, scuffed, and cracked, may be treated quite satisfactorily with pure neat's-foot oil or with a simple mixture of neat's-foot oil and castor oil, such as preparation 5.

Many bindings in the advanced stages, of decay or rot become powdery and are disagreeable to handle, soiling the hands and clothes with leather dust. Old law sheep bindings in this condition probably are the most familiar examples, but many bindings made from other kinds of leather peel and get powdery. Such bindings are on their "last legs," but they can be improved materially by treatment with a dressing followed 24 to 48 hours later by lacquering with a cellulose-nitrate lacquer. The leather should be well oiled or greased because it can not again be oiled after being lacquered. Care should be taken, however, not to put on so much dressing that the surface of the leather remains greasy as the lacquer then will not adhere.

If the surface of the leather is powdery and scuffed, a better result is often obtained by rubbing it smooth with crocus cloth or very fine emery cloth before the oiling and lacquering.

A thin cellulose-nitrate or soluble-cotton lacquer should be used. If the lacquer is too thick, a highly varnished appearance results and the lacquer is more likely to come off. There are on the market certain types of ready-made cellulose-nitrate lacquers, which may be used if sufficiently thinned with their respective thinners.

Lacquers made for leather, cloth, and similar flexible materials should be used, and not those intended for metal and wooden surfaces. The lacquer should not contain any gums or resins and preferably should have a high percentage of castor oil as softening agent or plasticizer.

A lacquer that may be used for this treatment has the following composition, the weights being given in ounces avoirdupois :

Cellulose-Nitrate Lacquer.

Cellulose nitrate, one-half second, for lacquers, ready mixed, with 30 per cent. by weight of alcohol	1
Monoethyl ether of ethylene glycol	2
Ethyl acetate	3
N-butyl alcohol	1
Toluene	5
Xylene	2
Castor oil	½

The first four ingredients are put in a glass fruit jar, or other suitable container, which is then tightly closed and allowed to stand with occasional shaking or stirring until a clear, thick sirup is obtained. The last three ingredients, mixed together, are then added in a thin stream with constant stirring until a uniform mixture results.

Dry cellulose nitrate or pyroxylin is dangerous to handle and ship. Consequently, it is usually sold, shipped, and kept mixed with 30 per cent. by weight of alcohol. Every precaution against fire and explosion should be taken when using cellulose-nitrate lacquers. Since these lacquers dry rapidly, they give off in a short time a relatively large volume of vapours and fumes, which ignite easily and burn freely and which consequently should not be allowed to accumulate in the room or place where the lacquering is being done. Furthermore, the vapours may have a disagreeable odour and be irritating to some persons. The lacquers should be applied preferably in the open or at least in a free circulation of fresh air. They must not be used near a fire or open flame, or while the person handling them is smoking.

A soft brush, with hairs set so that they will not be loosened by the lacquer, should be used. The lacquer should be flowed on with only one or two strokes and not worked out, by brushing back and forth, as this causes the lacquer to roll up. The brush should always be full of the lacquer. Sometimes more than one coat is needed, but in such instances, let the first coat dry before applying the second one. The brush should either be kept suspended in the lacquer or cleaned in acetone or a thinner immediately after it is used if it is to be preserved for future use. The lacquers are very volatile and must be kept tightly sealed when not in use.

Sometimes these lacquers partly dissolve and consequently spread the dye in title skivers, especially black skivers. This can be avoided by carefully putting the lacquer over the titles with one stroke of the brush.

Lacquered bindings will have a slightly shiny finish. Whether or not this is objectionable will depend upon individual taste.

(From *Leaflet* 69, U.S. Dept. of Agriculture.)

SEVENTY YEARS AGO.

(From the Chemical News, Feb. 18, 1860)

Improvements in obtaining or extracting Quinine and the Principal Organic Alkalies. (A communication.) W. Clarke.

A decoction of the bark in dilute hydrochloric or sulphuric acid is obtained; an alkali or alkaline carbonate is then added until precipation ceases. The liquor holding the precipitate in suspenson is then boiled, and a certain quantity of solid fatty acids added; these acids then melt and form a layer on the surface with which all parts of the liquid under the influence of ebullition come in contact successfully, and the quinine being dissolved in the water combines with the fatty acids and forms with it a perfectly insoluble soap. After a certain time the precipitate becomes of a blackish colour. The liquor is then allowed to cool, when the fatty acids become solidified on the surface, and are removed in the form of a cake and then boiled with distilled water for removing impurities with which it may be mechanically combined. This is continued until the latter matter yields nothing more to the pure water; it is then boiled in water acidulated with sulphuric acid, and the excess of acids subsequently saturated by an alkali. Some dark matters will be precipitated, and after fitration a crystallised block of sulphate of quinine will be obtained by cooling, which block may be purified as usual.

SYNTHETIC PERFUMES.

By H. STANLEY REDGROVE, B.Sc., A.I.C.

The science of chemistry has invaded almost every department of daily life, without the man in the street being at all cognizant of the debt he owes to it. Nor is it realized how many common domestic operations, like cooking a dinner, for example, really consist in causing a number of more or less complicated chemical reactions to take place in the materials employed. By the man in the street and the housewife in the kitchen, "chemicals" are thought to be substances of a nature quite distinct from the things they daily handle and to be chiefly characterized by the possession of a "nasty smell."

Synthetic perfumes have been criticized as having "coarse" odours. It will be appreciated that this coarseness may arise, not because of any positive property of the preparation, but because it lacks some of the essential "impurities." This explains why the growth of the synthetic perfume industry has not killed the natural perfume industry. Indeed, the effect has been quite the opposite, and the two industries are closely linked together. Chemical research has enabled many of the substances which are responsible for the sweet odours of flowers to be produced at a relatively low cost by synthetic means. Perfect perfumes, however, can not be made with synthetic materials alone; to produce quite satisfactory results a proportion of the necessary "impurities" must be introduced by mixing with the artificial product a small amount of the natural one. The consequent cheapening in the cost of perfumes has resulted in a big increase in the demand for them to the benefit of both sides of the perfume industry.

Some analogies can be drawn between the aniline dye industry and that of synthetic perfumes. We must not, however, fall into the error of the man in the street, who seems to imagine that every chemical product comes from coal-tar. Certainly many synthetic perfume materials do, though some of the most important are made from raw products of a quite different nature.

In this connection the question arises, Where is the line to be drawn between a natural product and an artificial one? Essential oils obtained from plants by steam distillation are classed as natural products; but it would be rash to assume that no chemical changes whatever take place as a result of this operation. In the case, for example, of bitter almonds, it is well-known that the essential oil is present in the kernels of the nuts, not as such, but in the form of a glucoside, amygdalin, which has first to be decomposed, the agent for effecting this decomposition, emulsin, being also provided by the kernels.

It seems reasonable, however, to class the products of such operations as steam distillation, and extraction with fats (enfleurage) or with neutral solvents like petroleum ether, as essentially "natural products," those obtained by the two latter processes having indeed special claims to be so considered, as their odours exactly represent those of the flowers from which they are derived.

By means of fractional distillation and, in some cases, by taking advantage of the property possessed by aldehydes of forming crystalline compounds with sodium bisulphite, certain of the constituents of essential oils can be isolated in a state of purity. Such products, usually called "natural isolates," are, of course, in no sense "synthetic"; but they may very well be classed with the substances of synthetic origin inasmuch as they are "pure." The oils distilled from certain species of grsses belonging to the genus *Cymbopogon* are especially useful owin gto their cheapness. Thus, from lemon-grass oil, distilled from *C. citratus* and especially *C. flexosus*, the important alcohol, citral, is isolated. Palmarosa oil, distilled from *C. martini*, contitutes the main source for the isolation of the alcohol, geraniol, one of the constituents of otto of roses. Cintronella oil, distilled from *C. nardus*, provides a further source of this alcohol. The aldehyde, citronellal, is also isolated from this oil. Another very important natural isolate is the phenol-ether, eugenol, obtained from oil of cloves. In some instances these "natural isolates" provide starting points for the synthetic production of other important odourous substances, of which examples will be mentioned later.

So far I have written as though the one object in synthetic chemistry as applied to perfumery, was the production by artificial means of the various constituents of floral ottos, in order that by mixing these together a chemically-exact replica of each and every otto might thereby be obtained. This is certainly one objective; but it by no means exhausts the field of research and

practical achievement. In some instances such as that of otto of roses, chemistry has admirably succeeded in its task, though, even so. the synthetic otto suffers from the imperfection common to all such preparations, and, for the production of scent which is unmistakably that of the rose, a small proportion of natural material must be added, preferably that obtained by enfleurage, or by the extraction of roeses with petroleum ether.

Artificial musks consist of nitro-aromatic compounds and bear no chemical relationship to natural musk whatever. The best is probably that known as "Musk Ambrette," which is a nitrated butyl-meta-cresol-methyl-ether. Other imitation musks are provided by "Musk Ketone" (di-nitro-butyl-meta-xylyl-methyl-ketone) and "Musk Xylene" (tri-nitro-butyl- meta- xylene). The first artificial musk of commercial importance, it is interesting to note, was discovered accidentally by Baur so far back as 1888.

Benzyl acetate has already been mentioned as the main constituent of the natural otto of jasmine. This is merely one of an enormous number of synthetically prepared esters which are valuable in in perfumery, compounds belonging to this type often having agreeable odours. Certain of the esters of salicylic acid and cinnamic acid are particularly useful. Methyl salicylate is well-known under the name of "oil of wintergreen." Amyl salicylate has a very pleasant odour, resembling that of certain species of orchids.

It is extensively employed in making artificial orchid and clover perfumes. Some of the esters of cinnamic acid are well adapted for perfuming face powders.

The flavour of vanilla is one universally liked. The odour of the natural product the dried an dcured fruits of *Vanilla planifolia* and allied species of orchids, is almost entirely due to the aldehyde, vanillin, the synthetic production of which is one of the great triumphs of synthetic perfume chemistry. Nowadays, the use of synthetic vanillin has largely replaced that of natural vanilla both as a flavouring agent and, especially, in perfumery. The substance is made by several processes, in England from oil of cloves, on the Continent from guaiacol. Added to a perfume, vanillin gives a quality of sweetness and softness. Moreover, it possesses good fiative powers serving to retard the evaporation of more volatile ingredients.

The synthesis from clove oil is of particular interest. The essential oil of cloves consists very largely of eugenol, which substance, as already mentioned, can be easily isolated from it. On treatment with caustic potash, eugenol undergoes an isomeric change, yielding iso-eugenol, itself a valuable perfume material, which forms the basis of most artificial carnation scents. On careful oxidation, iso-eugenol passes into vanillin.

Safrol, obtained as a by-product in the separation of camphor from camphor oil, undergoes similar reactions, being converted by treatment with caustic potash into the isomeric iso-safrol, which, when cautiously oxidized, yields the aldehyde, piperonal. This substance, better known as "heliotropine," exhales a delicious odour of heliotrope, in the flowers of which plant it probably occurs accompanied by vanillin and other substances of an odourous character. It is much employed in perfumery, being especially useful on account of its low price.

Another very inexpensive and agreeable artificial perfume material is terpineol, which i s manufactured from turpentine. This terpene alcohol has an odour resembling that of the lilac, and, being very resistant to the action of alkalies, is particuuarly adapted for scenting soaps and hair washes, for which purpose it is extensively employed.

A newer synthetic product, which enables a more exact imitation of the rather sharp odour of lilac blossoms to be obtained, is phenyl-propionic aldehyde.

Prior to the discovery of "synthetic violet," the preparation of satisfactory violet perfumes was a very difficult proposition, owing to the fact that the flowers contain only microscopic amounts of perfume material. The odour of the violet is a rare one in nature, orris-root and cassie (*Acacia farnesiana*) being about the only available natural sources from which a tolerable substitute for the violet can be obtained .

An investigation by Tiemann and Krüger of the constitution of the oil of orris-root revealed the fact that its odour is almost entirely due to a ketone, which was christened "irone." These chemists prepared an isomer of this substance by condensing citral with acetone. By heating this substance with dilute sulphuric acid in the presence of a little glycerol, it was hoped that an isomeric change would take place

resulting in the formation of irone. An isomeric change did take place; but the product was not irone, since synthesized by a diferent process. It was a substance, to be named "ionone," with an intense odour of violets, much nearer to that of the flower than the anticipated irone. Nowadays, ionone is the basic material of all violet perfumes, and is one of the most important synthetic products in the art of perfumery.

(Abstracted from *Science Progress*, July, 1929.)

THE AMERICAN CHEMICAL INDUSTRY.

(*N.Y. Guaranty Survey.*)

The American chemical industry has not been free from the depression that has gripped industry in general. The demand for chemical products held up rather well during the first quarter; but the full weight of depression, although somewhat delayed, could not be avoided when the chemical consuming industries further curtailed their operations. During the summer, the chemical markets were dull; but as autumn advances, reports indicate some improvement in demand. On the whole, the improvement in recent weeks is considered hardly more than the usual seasonal trend in this industry, although increased ordering in a few individual consuming industries lately has been of such a nature as to suggest some revival, however sliht, in these industries. Prominent among these are the glass, soap, paint, and textile industries. Prices of chemicals have shown a conformity to the general commodity price movement, with the index of chemical prices prepared by the Department of Labour showing a steady decline since the beginning of the year. The index nnmber for September stood at 90.9, based on the 1926 average as 100, as against 92.1 for the preceding month and 99.9 for the corresponding month last year.

Decline in Chemical Exports and Imports.

Not only has there been a decrease in the domestic demand for chemicals so far this year, but also the latest foreign trade report indicates that the absorption of American-made chemicals abroad has fallen off perceptibly. During the first nine months of this year the value of exports of chemicals and allied products amounted to $134,632,000, which marks a decrease of 15 per cent. below those a year ago. On the other hand, imports amounted to only $188,940,000, marking a decrease of 20 per cent. below those in the corresponding period last year. However, while there was a distinct recession in both categories of foreign trade, in view of the lower price levels, the actual decreases are exaggerated when expressed in dollar values; and the declines in the volume of both exports and imports were much less than the figures imply. In fact, one-third of the commodities in both the export and import groups actually registered increases in volume above the levels in the corresponding period last year.

The immediate prospects for improvement in this industry are almost entirely dependent on the course of general industry in the next few months, for the vast diversity in the types of industry that consume chemical products makes the demand for chemicals, which for the most part are producers' and not consumers' goods, very sensitive to the major business movements. Some idea of the scope of this industry, more particularly that part of it involving manufacturing operations, may be gained by reviewing the chart on this page. The general opinion regarding the outlook for the chemical companies in the last quarter of this year is that, inasmuch as output fell off in the last quarter of 1929, the level of production in the last three months of this year should not show so large a decline from that a year ago as was the case in the other three quarters of this year. One estimate anticipates a decrease of 2.5 per cent. in the movement of chemical goods in the last quarter of this year, as compared with that a year ago.

Among the chemical consumers that should influence the demand in the near future are the sugar, petroleum, and rubber industries. Sugar refining so far this year has compared unfavourably with that in recent years, and it is hoped that some improvement in this industry is in order. The consumption of rubber, particularly of rubber tyres, has been low; and should the recent reports of anticipated improvement in this line materialize, some branches of the chemical industry should benefit accordingly. On the other hand, any success resulting from the present efforts to eliminate the over-produced situation in petroleum refining would be reflected in a lessened demand for some chemical products.

The most encouraging feature in the near-term outlook for this industry is the low level of chemical inventories in the hands of the consuming industries. As is usual at times of gradual price recession,

consumers have adopted a policy of hand-to-mouth buying. With supplies in the hands of consumers only efficient for the current needs of their low levels of output, the chemical industry expects that any improvement in general industry will be followed immediately by increased chemical production.

At present the United States is the largest producer, consumer, and importer of chemical products, and second only to Germany as an exporter. Some idea of the growth of our chemical industry may be gained from a review of statistics index of general production, with seasonal movements eliminated, and the index of chemical production based on the consumption of electrical energy by the producers of chemical and allied products. It is interesting to note that the chemical curve, barring wide monthly fluctuations, shows an almost uninterrupted growth since 1923 and that an upward trend has been maintained even during the recent period of general industrial recession. This phenomenon does not indicate, however, that the total value of all chemical products has not declined in conformity with general industrial recession. Since the producers of highly processed chemicals consume more electrical energy than those of less refined products, the upward trend of this curve indicates not a complete defiance of total chemical production to general industrial levels, but rather the continuous growth that has been taking place in this branch of industry.

The long-term outlook for the American chemical industry is based on a set of factors related more to the progressive expansion of the industry than to its conformity to cyclical business movements. Prior to 1914, the United States was a large importer of chemicals and was almost entirely dependent on foreign sources for highly processed materials. The rapid development that has taken place since that year, stimulated mostly by the difficulty of obtaining chemical products from abroad during the war, reached what might be called a climax in 1929 when our production, exports, and imports reached record proportions. Inasmuch as only 8 per cent. of total domestic chemical production is dependent on export markets, the demand from American industry as a whole in normal times could almost absorb the present chemical plant capacity; and with the assurance of industrial progress in this country in the future, permitting a gradual expansion of chemical plant capacity, there is little likelihood that the American chemical industry will lose any of the ground that has been gained since 1914.

Beyond this point, however, further expansion must depend on the development of foreign markets; and, to judge by conditions as they appear at present, the American producers are apt to meet vigorous competition abroad. The chemical industry of Germany has been restored to its pre-war basis, while the chemical industries of France and England, which were developed during the war, must be considered. However, the American producers, with no attempt to minimize the resistance that they are bound to meet in further developing markets abroad, feel that with the tendency toward centralization in the American industry, more efficient production, and more aggressive marketing, foreign competition will be met with a reasonable measure of success.

Fertilizers.

Sales of fertilizers in reporting States so far this year have been slightly larger than a year ago; and although figures for recent months have not shown such a favourable comparison, it is likely that the total for 1930 will be approximately equal to that for 1929, which was the largest on record with the exception of that for 1928. These comparisons are based on fertilizer consumption in twelve Southern States, as indicated by tag sales. Reliable figures for the remainder of the country are not available, but the current rate of consumption is estimated at about $7\frac{1}{2}$ or 8 million tons. The twelve reporting States consume between two-thirds and three-fourths of the total for the entire country. It is believed, however, that the use of fertilisers in the States not covered by the reports is increasing faster than in the South.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Studies on the Adsorbed Moisture in the Kanbara Clay. By Hajime Isobe.

On the Nature of Japanese Acid Clay. A Reply to Mr. Isobe's Criticism. By Naondo Kameyama and Shumpei Oka.

Terpenes and Related Compounds. VI. Methoxyisobeugenol and -isochavibetol. II. By Nenokichi Hirao.

Starches. I. Starches from Various Species of Plants. I. By Gisaburo Kashiwaya.

Proteins. VIII. Proteins from Soy-beans. I. By Shigekiyo Suzuki.

Alginic Acid. By Tomowo Miwa.

DIATOMITE IN CANADA.

The large increase in the annual consumption of diatomite is mainly due to the successful research work on its domestic and industrial uses. Diatomite is used in industry as a heat and sound insulator; as a filter medium and as an admixture in cdncrete. It has few, if any, equals as an insulator against heat and is absolutely fireproof. When used in filtering certain solutions rapid and clear filtration is accomplished. An important development of 1930 is in its use as a constituent of asphalt battery boxes and hard rubber products. Several manufacturers of these commodities in Canada have successfully adopted diatomite to their use during the current year.

There are numerous deposits of diatomite in Canada, many of which are of high quality, but production is comparatively small and is far below domestic consumption requirements. Recent interest in the material has acted as a stimulus anr preparations are being made by several firms to increase their output. During the year the Oxford Tripoli Company was reorganised as the International Diatomite Industries, Limited, and took over the Scotia Diatom Products Company's deposits at Digby Neck, Nova Scotia. It also acquired many of the best deposits both in Nova Scotia and in New Brunswick. The Company recently erected a treatment plant at the Digby deposit which has a potential supply of about one million tons of finished material. They are now producing both from the latter as well as from their original deposits south of Tatamagouche, N.S. In Ontario, the Diatomite Products, Limited, have almost completed their treatment plant, situated at Martin's siding, Muskoka. The material is pumped from a lake to a settling pond at the plant. Production is expected to begin in the spring of 1931. During the past two or three years the British Columbia Refractories Limited, Vancouver, have been operating the diatomite deposits at Quesnel in the Cariboo district of Central British Columbia. These are the largest known deposits in the Dominion and accur as dry chalk-like beds of some 60 feet in thickness, above the Fraser river. The price varies according to purity and use, ranging between $25.00 to $60.00 per ton. On account of the high freight rates from the west, the eastern Canadian producer has an advantage over his large California competitor.

GENERAL NOTES

NON-FERROUS METAL SMELTING AND REFINING IN CANADA.

Although the base metal market situation has in recent months tended to arrest the rate of expansion in Canadian metal production, the statistics for 1929 just issued at Ottawa reveal a decided advance as compared with those for 1928.

According to the Dominion Bureau of Statistics at Ottawa, the production of the Horne Copper Corporation at Noranda, P.Q., showed a decided increase over that of 1928. The Aliminium Company of Canada, operated both their Shawinigan and Arvida plants, utilizing alumina and imported Bauxite ores.

In Ontario, the International Nickel Company continued a programme of steady expansion, both in metallurgical and mining developments. Matte was shipped to Clydach, Wales; Huntingdon, West Virginia, U.S.A., and to the Port Colborne refinery, the latter plant producing converter copper, refined and electrolytic nickel and residues containing metals of the platinum group. Monel metal was made and gold and silver recovered in foreign works. The Kingdon Mining, Smelting and Manufacturing Co., Ltd., Galetta, produced pig lead directly from the Kindon mine concentrates; cobalt-silver ores from Cobalt, South Lorrain and Gowganda districts were treated in the plant of the Deloro Smelting and Refining Co., Ltd., production from which included fine silver, metallic cobalt, cobalt oxides and salts, nickel metal, nickel oxides and salts, white arsenic, cobalt alloys, etc.

The industry in British Columbia preserved a steady improvement, the large Trail works of the Consolidated Mining and Smelting Company, Ltd., produced lead, zinc, silver, copper, gold, bismuth, and cadmium from both customs ore and tonnage from their own mines, chief of which is the Sullivan, a mine possessing one of the world's greatest known silver-lead-zinc deposits. The same company operates a large concentrator, treating both their own and ores from other properties. The Granby Consolidated Mining, Smelting and Power Company showed an increase in blister copper production, this was exported to United States refineries. The smelter utilised both customs ore and those from their Hidden Creek mine.

Capital invested in lands, buildings, plant, machinery and tools, cost of supplies and stocks on hand and cash in the non-ferrous metallurgical industry in Canada amounted to $146,699,085 in 1929 as against $120,035,742 in 1928. There were 684 salaried employees and 7,435 wage-earners who received $13,772, 393 for their services. Fuel and electricity cost $6,208,733, in addition to which coke to the value of $3,280,757 was used for smelting. Total power employed was 258,848 h.p., comprising 13,186 h.p. generated by steam engines and steam turbines, 220 h.p. from gasoline, oil and gas engines, 65,160 h.p. applied by hydraulic turbines and water wheels and 180,282 h.p. by electric motors which were operated by purchased power. In addition there were 486 other electric motors in use having a sombined rating of 12,820 h.p. which were operated on energy generated by the primary power of the industry. The estimated value of ore charged to the furnace was $41,416,446, and the sales value from the smelters amounted to $109,854,468, indicating that the value added by converting the ore to saleable products was $68,438,022.

TRAMWAY STANDARDS AS LAMP-POSTS.

Street Experiment with Six Types of Lighting.

Birmingham Corporation is making use of old tramway standards for an experiment with types of gas and other forms of lighting.

The road chosen is the Hagley arterial road; and in each of the six sections in which the test is being made notice boards have been placed giving particulars oft he various types of lamp used.

The experiment is creating a great deal of interest both among motorists and the general public, following, as it does, the recent test at Lewisham, when experts decided that high-pressure gas-lamps were both the cheapest and brightest form of street-lighting.

MARKET FOR DISINFECTANTS, INSECTITUDES AND ANIMAL DRESSINGS IN HOLLAND.

A confidential report on the market for disinfectants, insecticides and animal dressings in Holland has been prepared by the Department of Overseas Trade from information furnished by His Majesty's Consul-General at Rotterdam and issued to firms whose names are entered on its Special Register.

PETROL FROM CANARY ISLANDS.

New Refineries Producing 5,000 Barrels a Day.

New petroleum refineries have just been opened at Santa Cruz de Teneriffe (Canary Islands), with a present capacity of 5,000 barrels daily. Several shipping lines have indicated their intention of refuellin gat this installation.

The refinery which is owned by the Compania Espanola de Petroleos, covers an area of 2,150,000 square feet and is connected with the loading wharf by a pipe line nearly three miles long. Although it is not yet working at full pressure, lareg consignments of gasoline are already being despatched. A cargo of 9,500 tons has been taken by one vessel and three other tankers will sail this month with quantities of 9,000 tons, 10,000 tons and 9,5000 tons respectively. The refinery will also supply the oil requirements of the Islands.

The plant is equipped with the most modern apparatus and 150 men, working three shifts of eight hours a day, will be able to maintain full capacity.

GLASS-LINED TANKS.

The evolution and adoption of Glass-Lined Steel Vessels in industry is due in a large measure to the widespread use of glass in the hygienic marketing of edible and other susceptible products, the present day tendency being with up-to-date firms to employ glass throughout the various processes of manufacture and for transport.

Apart from the hygienic aspect, it has become incumbent upon all manufacturers of food products to instal equipment of such design as fill enable rapid cleaning to be effected with the utmost efficiency. These conditions fully obtain with our glass lined tanks, the smooth interior surface, absence of crevices and sharp corners entirely eliminating any possibility of residual accumulation or adhesion of the product.

The inert properties of glass ensure complete immunity from discolouration and detriment to the flavour of the product, and prevent contamination due to metallic influences.

In the manufacture and handling of food products in vessels of nickel, tin and aluminium it is not generally appreciated that more or less specific absorption of the metal takes place, resulting in numerous instances in the formation of injurious metallic salts may in some cases give rise to the spoilage of the product.

Where dealing with milk it becomes imperative that the utmost precautions are taken to ensure handling under absolute sterile conditions, and it is here that the Glass-Lined Steel Vessel excels, cleanliness and flexibility of control obtained during treatment of the milk making Glass-Lined Equipment a necessity.

Since the introduction of Glass-Lined Equipment into the Dairy Industry it has been definitely established that in the process of pasteurization the vitamin value of the milk is fully retained, this being attributed to the absence of metallic contamination. With the bulk storage and transport of milk in our Insulated Glass-Lined Steel Containers, it is possible to maintain a very low lactic acid content consistent with a low temperature and, most important of all, an improvement in the keeping qualities of the milk by reason of the low bacteria count present.

The conventional wood vats at one time universally employed in beer and vinegar breweries are giving place to modern Glass-Lined Vats with their attendant advantages, periodical pitching and varnishing being rendered unnecessary. The ease with which Glass-Lined Vats can be cleaned cannot be over-emphasized, and the consequent freedom from infection and organic growth is appreciated by all users.

BRITAIN'S NEED FOR NON-SKID ROADS.

A resolution urging the importance of providing British roads with non-skid surfaces has been sent to the Minister of Transport by the National Committee of the Passenger Service Group of the Transport and General Workers' Union.

More than 100,000 transport workers, including 'bus and motor-coach drivers, are represented by the group, whish has taken this action as a result of the increasing number of accidents which have been reported by their members as being due to slippery roads.

"Many of our members are experienced drivers," said Mr. Harold E. Clay, the Secretary, last night, "and after hearing their views we have come to the conclusion that it is the material used on the roads which is largely to blame."

"We believe that tar-sprayed roads with good-sized chippings lightly rolled in provide the safest surfaces. Roads which are shiny and smooth are most dangerous."

DYESTUFFS (IMPORTED REGULATION) ACT, 1920.

Applications for Licences in November, 1930.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during November has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 483, of which 396 were from merchants or importers. To these should be added 10 cases outstanding on the 31st October, 1930, making a total for the month of 493. These were dealt with as follows :—

Granted—460 (of which 444 were dealt with within 7 days of recipt).

Referred to British makers of similar products—18 (of which 13 were dealt with within 7 days of receipt).

Outstanding on 29th November—15.

Of the total of 493 applications received, 457 or 93 per cent. were dealt with within 7 days of receipt.

THE FERTILISER TRADE IN CANADA.

The Monthly Bulletin of Agricultural Statistics for September, just received at the Canadian Building, Trafalgar Square, London, S.W.1, contains a survey of "The Fertiliser Trade in Canada," July 1, 1928, to June 30, 1929, prepared by W. H. Losee, B.Sc., Chief of the Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics.

The survey in question contains an analysis of the trade by the 67 concerns engaged therein, the tonnage marketed being shown as 359,600 tons, of which 135,850 tons were exported.

THE ROYAL TECHNICAL COLLEGE, GLASGOW.

The Annual Report for the 134th Session was duly adopted at the annual meeting of the Governers, on October 21, 1930. The Report is an interesting synopsis of the many and varied educational activities of the College.

The report shewed that the slight upward tendency in the number of regular day students has been maintained during the past session. The state of the great in-

dustries with which the main work of the College is connected has usually been reflected in the past by the number of full-time students, and this increase is, therefore, particularly welcome. It is doubtless the case that many students who, in normal times, would have entered one of the industrial professions, have been attracted to commerce and distribution rather than to production during this period of industrial depression, and it is perhaps to this cause that, for example, some part of the extraordinary influx of students to the College Departments of Navigation and Pharmacy is to be ascribed. But in Electrical Engineering it is well known that the industry has not suffered to the same extent as other branches, but the demand for electrical engineering graduates has far exceeded the supply, and it is now no uncommon thing for all the day students in the Departments about to complete their course to have received appointments before the end of the winter session. The majority of these students are engaged by the larger English firms, and the remuneration now offered by these firms, liberal in the light of past experience, both to undergraduates during vacations and to graduates, doubtless accounts to some extent for the relatively large number of electrical engineering students despite the scarcity of local employment in this branch.

The numbers of individual students compared with the previous session are as follows :—

	1928-29	1929-30
Day students	967	1,008
Evening students ..	2,939	2,949
Total	3,906	3,957

The number of students in continuation classes affiliated to the College was 4,571, as compared with 4,232 in the preceding session. The affiliation scheme is under the supervision of a Joint-Committee representative of the Education Authorities of the neighbouring Counties and of the College, and during the past year has continued to operate with success.

The Ordinary Certificate, under the scheme for National Diplomas and Certificates, already referred to, is issued through the Joint-Committee and was gained by 98 students.

The total income was £78,833 and the expenditure £78,555.

Proceedings and Notices of Societies

THE OPTICAL SOCIETY.

A meeting of the Optical Society was held at the Imperial College of Science and Technology, South Kensington, on Thursday, December 11, 1930. The following papers were read :—

New knowledge on Old Telescopes. By T. H. Court and Moritz von Rohr.

The paper is mainly historical. Early optical history is greatly indebted to these authors for several important papers.

On Interpolating Refractive Indices. By Mrs. B. Gifford.

Formulae are obtained which gave rise to a discussion of much interest.

On the Determination of the Transmission Factors of Coloured Step Lenses. By H. Buckley, of the National Physical Laboratory.

In the 1928 report of the International Commission on Illumination's Committee on Coloured Glass for Signal Purposes, an outline of a method of measuring the transmission factors of coloured lenses use in railway signals is given. The deduction from the assumption made in this report is shown to be incorrect.

The Chair was occupied by the President, Dr. F. Twyman, F.R.S.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

At the monthly council meeting on December 10, the chemical report was introduced by the Chairman, Mr. H. Dent Brocklehurst who said that the list of analyses made by Dr. Voelcker for members during the month of November had been submitted to the Committee. Dr. Voelcker had reported the result of the hearing of the appeal in the case of Dobell and Co., Ltd., v. Barber and Garrett, from a decision of Mr. Justice Roche, limiting the amount of damages to which the plaintiffs were entitled. The case concerned the sale of linseed cake which was found to contain castor oil bean and had proved fatal to stock to which it had been given. The Lords Justices confirmed, by a majority, the decision of Mr. Justice Roche as regards liability under the Fertilisers and Feeding Stuffs Act, but as regards the incidence of liability varied Mr. Justice Roche's judgment, and awarded to the

plaintiffs the whole of the damages and costs which they had incurred by reason of the harm done by feeding the cake to cattle.

Dr. Voelcker reported generally on the proceedings at the recent meeting of the Advisory Committee of the Ministry, when the subject of barley meal had been further discussed.

A letter from a member had been read in which he complained of the issue by the Society of "Occasional Notes" containing a statement of the ruling given in July last on the matter of barley meal. He objected to this being put forward as a decision having legal force. The Committee, after considering a note which Dr. Voelcker had prepared in reference to this, pointing out that the decision held good until upset in a higher court, had directed the Secretary as to the reply to be made.

The Committee estimated that for the ensuing year their expenditure would amount to £400, plus the amount of laboratory petty cash.

During the year they had met eight times and had made eight reports.

The Committee had expressed their regret at the retirement of Mr. H. Dent Brocklehurst, who had been their Chairman since 1928.

Mr. Brocklehurst, in presenting this Report, said that the Committee wished to associate themselves with the expression of regret at the death of Mr. Macdonald. The Committee had been hoping that his abilities and genility would be at the service of the Council for many years to come.

The Report was adopted.

NOTICES OF BOOKS.

Bell's Sale of Food and Drugs. Eighth Edition, by R. A. Robinson, Barrister-at-Law. Pp. xxvi + 300 + 34. London: Butterworth & Co., Bell Yard, Temple Bar, E.C. 1931. Price 15s.

The earlier editions of this work were devoted almost exclusively to a consideration of the sale of Food and Drugs Acts, but the scope of the latest edition has been enlarged to incdlude an account of the mass of recent legislation which has been enacted in the last decade. This has involved alterations in the arrangement of the matter, but the same method of treatment has been retained. The annotated statutes follow in order of date and after them Statutory Regulations and Orders, classified in groups.

A list of official publications is given in the form of an Appendix.

The present edition should prove invaluable to chemists, analysts, inspectors, and others concerned in any way with the administration of the various statutes.

A School Course of Chemistry. By Prof. J. R. Partington. Pp. x + 388. London: Macmillan & Co. 1930. Price 4s. 6d.

As Prof. Partington says in his preface, there are already so many textbooks and manuals of chemistry that the fundamental facts and principles are the same in all such works. Yet no two chemistry books are identical and nearly all possess some advantages and outstanding merits from the standpoint of the teacher or the student. Science books, no less than fiction, must establish themselves by their merit, either in sustaining the reader's interest or in presenting the subject matter in a lucid manner and in affording a correct view of the subject. In all these respects Prof. Partington's works have succeeded and through his various textbooks he reaches every type of student. His comprehensive and exhaustive *Textbook of Inorganic Chemistry* meets the needs of university students, and those desirous of a detailed account of the elements and their inorganic compounds, together with the theory which binds the science together.

Everyday Chemistry presents the essentials of chemistry in a most readable form which appeals equally to schoolboys and older readers desirous of acquainting themselves with the elements of chemistry, particularly directing attention to those facts and principles which are made use of in daily life.

Finally there comes *A School Course of Chemistry* which, although not containing half the contents of *Everyday Chemistry*, is written in the same pleasantly readable style and which is intended as a textbook for matriculation students. It could well serve as the book used throughout a four or five years' course of chemistry.

From general observations and experiments, conclusions are inferred and the subject is gradually developed until the fundamental laws are explained about halfway through the book. After this a more systematic description of the various elements and their more important compounds is given.

The book contains many valuable suggestions in the way of introducing new or varied experiments and also in the mode of presenting certain topics. These points will commend the volume to science masters, to whom it should prove most useful.

J. G. F. Druce.

Die Natürlichen und künstlichen Asphalte. By PROF. J. MARCUSSON (Zweite, verbesserte Auflage herausgegeben unter Mitwirkung von PROF. H. BURCHARTZ UND PROF. P. WILKE). Pp. xii + 253. Verlag Wilhelm Englemann, Leipzig. 1931. Price 17 marks.

Prof. Marcusson's work deals with the extraction, treatment, application and composition of the natural and artificial asphalts. The various natural products from Syria and Trinidad are compared and contrasted with the artificial by-products resulting from petroleum distillation and those obtainable from pitches and tars.

The second part, which is perhaps the more important technically, deals with the methods of examination of various asphalts and their evaluation.

In this edition Profs. Burchartz and Wilke have assisted in revising and extending Prof. Marcusson's important and standard work.

OFFICIAL PUBLICATIONS RECEIVED.

DEPARTMENT OF OVERSEAS TRADE,
35, Old Queen Street, London, S.W.1.

Hints for Commercial Visitors to Egypt.

Hints for Commercial Visitors to Algeria, Tunisia, Tripolitania and Cyrenaica.

DEPARTMENT OF MINES, CANADA.

Investigations of Fuels and Fuel Testing No. 712 (I) Report of preliminary carbonization and briquetting tests on lignite from northern Ontario. By R. A. Strong. (II) Report on oil-shale from Pictou country, Nova Scotia : By A. A. Swinnerton. (III) Laboratory Notes : By J. H. H. Nicolls—

(I) Under Water Storage of Saskatchewan lignite.

(II) Effects of prolonged weathering on friabilities of certain coals.

(III) Observations concerning organic and other forms of suphur in coals containing large amounts of sulphur.

IV. Analyses of coals and other solid fuels; compiled by J. H. H. Nicolls and C. B. Mohr.

V Gasoline survey for 1928; By P. V. Rosewarne and R. J. Offord.

UNITED STATES DEPARTMENT OF COMMERCE.
Bureau of Standards. Washington D.C.

Bureau of Standards, Journal of Research. Volume 4, January to June. Research Papers Nos. 120 to 182.

Washing, Cleaning, and Polishing Materials. No. 383. Price 10 Cents.

American National Special Screw Threads. Commercial Standard CS25-30. Price 15 Cents.

American National Standard Screw Threads. Commercial Standard CS24-30. Price 10 Cents.

Feldspar. Commerical Standard CS23-30. Price 5 Cents.

Simplification of Sizes and Terminology of High Volatile Bituminous Coal.

Miscellaneous Publication No. 113 Regional Recommendations R.R.1-29. Price 5 Cents.

Annual Report of the Director of the Bureaus of Standards to the Secretary of Commerce for the Fiscal Year ended June 30, 1930. Price 10 Cents.

An Improved Victor-Meyer Molecular-Weight Apparatus. By M. M. Hicks-Brunn. Research Paper No. 215. Price 5 Cents.

Additional Agents in Copper Electrotyping Solutions. By R. O. Hull and W. Blum. Research Paper No. 228. Price 5 Cents.

Standards and Specifications for Non-metallic Minerals and their Products. By John Q. Cannon, Jr., under the Direction of A. S. McAllister, Chief of the Division of Specifications. Miscellaneous Publication No. 110. Price 12.75.

SCIENTIFIC PAPERS OF THE INSTITUTE OF PHYSICAL AND CHEMICAL RESEARCH.

271. A Study of the Decomposition of Patassium Ferrocyanide and of Potassium Ferricyanide by the Autoclave Treatment. By T. Katsurai and T. Watanbe.

272. Researches on the Cutting Force. II. Cutting Action of Planing Tool. By M. Okoshi.

273. Grain-Growth of Marble. By M. Kuroda. Price 75 Sen.

UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY.

Geology and Mineral Resources of Parts of Carbon, Big Horn. Yellowstone, and Stillwater Counties, Montana. By R. S. Knappen and G. F. Moulton. Bulletin 822-A. Price 25 Cents.

Surface Water Supply of Hawaii. July 1, 1925 to June 30, 1926. N. C. Grover, Chief Hydraulic Engineers. Water-Supply Paper 635. Price 25 Cents.

Forthcoming Events.

THE ROYAL INSTITUTION.

JUVENILE LECTURES.

"The Electric Spark." By Prof. A. M. Tyndall, D.Sc., M.R.I.

Tuesday, January 6, 1931, at 3 p.m.—IV. "The Mechanism of a Spark and Other Forms of Discharge."

The colours of the discharge can be varied by using other gases, such as neon, instead of air. The study of the discharge through so-called vacuum tubes led to the dis covery of the electron and of X-rays. Electrons form part of the structure of all atoms and molecules. Under certain conditions some of the molecules of a gas may be ruptured so that each gives rise to a negative electron and a positive residue. These carry the electric current of the discharge. Free electrons may also be produced from metal surfaces as in a wireless valve and in a photo-electric cell. These processes throw light on the mechanism of the electric spark.

Other forms of electrical discharge are possible, such as point discharge, brush discharge, and the electric arc. The former can be used to precipitate fumes from factory chimneys. An electric arc can be used as an intense source of both light and heat.

Thursday, January 8, 1931, at 3 p.m.—V. "Some properties of sparks and arcs."

Analysis of the spectra of various types of electrical discharge explains their characteristic colours, and has been used to study the structure of atoms. Sparks and arc are rich sources of ultra-violet light.

Sparks may produce chemical action, such as the ignition of a gas jet and of petrol and air in a motor-car engine. Millions of sparks are produced hourly for this purpose by magnetos. Arcs may be used to extract nitrogen from the atmosphere for industria lpurposes.

The duration of an electric spark is exceedingly short. For this reason it has been used in special types of instantaneous photography. In many cases the electricity oscillates to and fro across the spark gap. These oscillations, though exceedingly rapid, may be detected. They played an important part in the discovery of wireless waves.

Saturday, January 10, 1931, at 3 p.m.—VI. "Large sparks."

A "Tesla" coil produces high voltage and gives sparks and discharges with special properties. Much longer sparks, large generators giving one or more million volts. Nature provides the greatest sparks many feet in length, can be obtained from of all in lightning. Electric charges may be generated in clouds in enormous quantities. The rain falling from them is electrified. The study of lightning flashes is now being carried out in various ways. Even the atmospherics which trouble us in broadcasting give useful information. The problem of protecting buildings from lightning presents special difficulties. Faraday carried out a wonderful experiment with a large cage in the theatre of the Royal Institution. It can be shewn that such a cage will give to anyone inside it complete protection from electric sparks.

SOCIETY OF DYERS AND COLOURISTS.

At the joint meeting with the Mauchester Sections of the Society of Chemical Industry and the Oil and Colour Chemists' Association at 7 p.m., on Friday, January 9, at 36, George Street, Manchester, a paper on "Human Factors in Colour Judgment" will be read by W. O. D. Pierce, Esq.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

36,962.—I. G. Farbenindustrie Akt.-Ges.—Simultaneous recovery of fatty acids and valuable salts. December 8.

36,965.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of acetylene. December 8.

37,127.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of aromatic hydrocarbons and acetylene. December 8.

37,261.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of anthraquinone compounds. December 10.

Specification Published.

314,804.—Newport Co.—Preparing amino-benzyl-ortho-benzoic acids.

319,278.—Foldi, Z.—Process for the manufacture of C-alkyl and C-aralkyl derivatives of aromatic compaunds.

389,516.—Bloxam, A. G. (Society of Chemi- Industry in Basle).—Manufacture of dyestuffs of the anthraquinone series.

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INVESTIGATIONS OF LONG HEAT RAYS.

In *The Journal of the Franklin Institute* (1930, *210*, 689 to 792), Professor W. F. G. Swann gives a long report on the work of the Bartol Research Foundation, 1929-1930, as presented at the Stated Meeting, April 16, 1930. The following is taken from the report under the sub-title as given first above. It is of particular interest to the chemist as well as the physicist to follow up any ideas which may bring out the behaviour of things atomically small by some sort of experiment involving things of relatively large dimensions. This will be better understood from the following:—

One of the most curious facts which strike anyone who makes a survey of physics for the first time is the apparent contrast between the way in which things happen in things of gross size, and the way in which they happen in the atom.

* * *

The scaffolding of our thoughts had conformed *to the frame of nature, so as to fit* the grosser lines of its structure at a time before the fine architecture of that structure had revealed itself.

* * *

Nevertheless, it would be an interesting thing if one could take something which was of dimensions comparable to those which man can construct, and actually see it behaving as an atom behaves. Now such a situation seems just within the reach of practicability, and we are at present pursuing investigations along these lines. Let me cite one or two experiments which we are carrying out to test some of these matters. Let us concentrate our attention for a moment upon the waves emitted by

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a hot body of the order of one hundredth of a millimetre in length, and upon a band of those waves corresponding to a range of about one thousandth of a centimetre in wave-length. Now we have been accustomed to think of the mechanism of absorption of radiation by a body through which the radiation passes, as arising from little oscillators of some kind, which are set into vibration by the radiation and abstract energy from it. In particular, in considering this matter mathematically, it has been customary to adopt a rather abstract point of view. We consider a box of material which acts as the absorber, and we consider that little box as a whole as regards the motions within it. If we take a string and twang it in the middle, it will vibrate as one piece. If we constrain the midpoint to remain at rest, it will vibrate in two halves. If we constrain a point one-third of the way along to remain at rest, it will vibrate in thirds, and so on. We know that it is possible to represent any irregular motion of the string by a suitable combination of motions of these simple types. And so it is possible to represent any complicated electromagnetic disturbance in our box as something made up of simple oscillations having definite relations to the dimensions of the box. It has been customary to associate each of these oscillations with an independent oscillator which can respond to the frequency of vibration transmitted through the medium. These are the oscillators which absorb the energy from the oncoming wave. It is also these oscillators which are responsible for the emission of heat from the body when it is radiating. It is a characteristic feature of the absorption of radiation that oscillators which are mainly responsible for the absorption of radiation of any given frequency are those oscillators which themselves have a frequency almost equal to that particular frequency. It is also easy to see that the wave-length corresponding to the lowest frequency in a situation of this kind is comparable to the dimensions of the box. Suppose now we should send upon this box radiation which is composed of wave-lengths which are for the most part smaller than the dimensions of the box, then we shall always be able to find oscillators which are in a position to respond to that radiation and so cause absorption of it. On the other hand, if we should send on to the box radiation of a wave-length longer than its dimensions, the box would have no oscillators which would be capable of responding to the radiation, and the radiation would fail to be absorbed. It is only for the purpose of mathematical simplicity in speaking about the problem, that we confine our attention to a rectangular box of this kind. We may say, in general, that if a particle has any given dimensions, then it may be expected to fail to absorb radiation of a wave-length longer than those dimensions. Thus, if we should imbed in an insulator a lot of metal particles of dimensions of the order of one hundredth of a millimeter and should direct upon them radiation of successively increasing wave-lengths, diminution of the power of the medium to absorb should be observed when a wave-length of the order 0.01mm. was passed. In such a case we should have a result following from the co-operation of a thing of almost man made dimension, of the small particle, and a wave motion produced not with a radio apparatus of man made construction, but one produced by the subtle performances of atomic systems. Again, at sufficiently low temperatures, the oscillations which are concerned in heat motions are preponderantly of wave-length sufficiently large to be comparable to the diameters of small wires which can actually be produced. If then, for various temperatures of the surroundings, we should measure the rate at which heat is radiated from such wires when raised a fixed amount above the temperature of the surroundings, we should find a sharp change in the radiation as the temperature of the surroundings passed through that region for which the wave-lengths for maximum energy radiation became comparable to the diameter of the wires. Again, a careful investigation of the law of the variation of heat radiation with wave-length and temperature at low temperatures should be of particular interest, because from such data we have means of ascertaining whether oscillators of relatively large size are behaving accordingly to the simple theory of days gone by, or are participating in what would be, for them, the extraordinary phenomena of experiencing "quantum jumps" in energy.

* * *

It is by a series of investigations of the foregoing kind that we are endeavouring to seek as much light as possible upon the manner in which the phenomena of the large scale things of life and those of the atom merge into each other.

F. H. L.

THE ELECTRONIC STRUCTURE OF ORGANIC COMPOUNDS.

By Ingo. W. D. Hackh,
San Francisco, California.

The modern concept of atomic structure is beginning to enlighten us in the century-old problem : " What holds the atoms in the molecule together?" Affinity, attraction, electric force, valency, bonds, or the illustrative hooks or hands were and are some of the terms used to describe the phenomenon of chemical bonds or linkage between the atoms. To be sure our modern picture of the forces (electromagnetic in nature) holding the atoms together is not completely finished; science approaches, never reaches, the first cause. Nevertheless we can formulate some theory as to the nature of these chemical bonds by which we may predict the behaviour of the compounds.

The organic chemist chooses the tetrahedron as the geometrical form of the carbon atom, for this form explains stereoisomerism, cis- and trans-isomerism, triple bonds and related phenomena. The modern physical chemist likewise prefers the tetrahedral shape for all atoms. The cubical atom merely by drawing the electrons together, so that the eight electrons situated at the corners of a cube, become four electron pairs, situated at the corners of the tetrahedron.[1]

Naturally no one today conceives of this tetrahedron being solid and although we draw geometrical figures, we realize that the atom is empty, save for the minute nucleus and the surrounding electrons. The tetrahedron represents, so to speak, a geld of force, with the corners notating the direc-

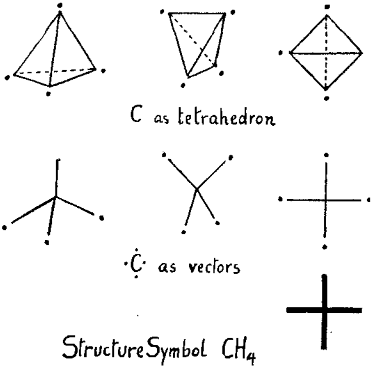

Fig. 1.

tion or points of attack. Simpler is it perhaps to picture the tetrahedral atom by four vectors running from the centre to each of the four imaginary corners. Still more conventionalized is the structure symbol[2] which pictures the carbon atom in the position of a tetrahedron looked upon edgewise and perpendicular to the edge. In figure 1 these three methods of representing the carbon atom are compared by illustrating the valence electrons by a dot.

The valence electrons are thought to be responsible for the bonds; in fact many properties of the atoms are traced back to them. Their number may be from one to eight, according to the position of the element in the periodic system. The atoms concerned mostly in organic compounds are

hydrogen (and alkali metals)	with	one	valence	electron
carbon (also Si, Pb, etc.)	,,	four	,,	,,
nitrogen (also P, As, etc.)	,,	five	,,	,,
oxygen (also S, Se, etc.)	,,	six	,,	,,
chlorine (also Br, I, etc.)	,,	seven	,,	,,

According to the Lewis theory each atom (except hydrogen) is normally satisfied whenever surrounded by an octet, that is four pair of electrons. In a compound this number eight is normally reached by sharing the necessary electrons with other atoms, each " pair " constituting a bond whenever each of the two atoms has contributed one electron to the pair. Thus in the Lewis notation the normal atoms are

H.   .C.   .N: :O: :Cl:

and the compounds formed from these :

H : Cl :   H : O : H   H : N : H   H : C : H

Oxygen is bivalent, because it contributes two electrons to the two pairs which are shared with the hydrogen; carbon is tetravalent because it contributes all four electrons to the four electron pairs.

Considering carbon-carbon bonds we may illustrate the single, double and triple bonds between the carbon atoms as follows :

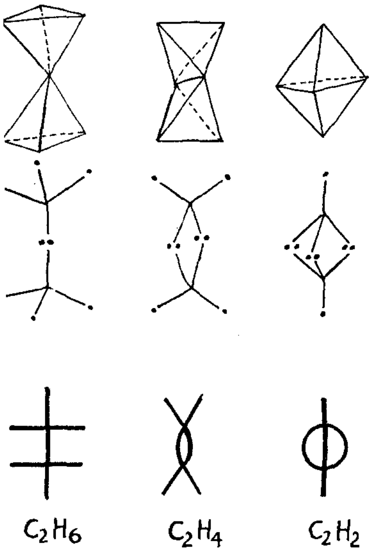

Fig. 2.

In these comparative figures only the electrons of the carbon atoms are shown, they would correspond, with the exception of the structure symbols, to

$$-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}- \quad >C=C< \text{ and } -C\equiv C-.$$

We shall now focus our attention upon the electron pair which constitute a " bond " and consider their motion and their position.

As to motion we have evidence that these two electrons are not at rest but describe an orbit. Electrons in a circular orbit, that is an " electron ring," has magnetic moment and constitutes a Bohr magneton. This may attract the two nuclei, but their positive charge will be repulsed by the negative charge of the electrons. Nevertheless this electron ring keeps the two nuclei in a definite position. The phenomen *of excitation and irradiation* require that these electron pairs have larger or smaller or more elliptical orbits, thus changing slightly the position of the nuclei to *each other. It is very probable that living* protoplasm, the living matter of the cells, consists of excited molecules; that is molecules in which the electrons are in excited orbits.

As to position we find that the electron pair may shift more to one than the other atom, the atom which it approaches *becomes more electronegative, the other atom* more electropositive. Hence the term polarity. A typically non-polar bond is one in which the electron pair is shared equally. A polar bond is one in which it is shared unequally. This shift of the electron pair has been depicted in various ways by the distance of the dots or circles indicating the electron pair, thus

A.............:.........B or A.......:....o.........B
A.........:............B or A.........o............B
A......:...............B or A......o...............B
A...:..................B or A...o..................B

where the electron pair shifts more and more toward A, hence A becomes more and more negative with respect to B.

The Lewis formula gives us the number of electrons, the polarity formula shows the relative distance, that is the negativeness or positiveness of the atoms concerned and the electronic structurd symbol combines the advantage of both notations, thus :

In the structure symbols the dots upon a line indicate the electrons which are shared and constitute the bond, those which are not shared surround the particular atom.

This notation may at first sight appear complicated, but will lose its complexity by assuming as fundamental principle the postulate : The electron pair constitutaing a bond will shift toward that atom which has the largest number of unshared electrons. Thus the shift will be greatest toward the halogens, next to oxygen, less to nitrogen, and not at all to carbon or hydrogen.

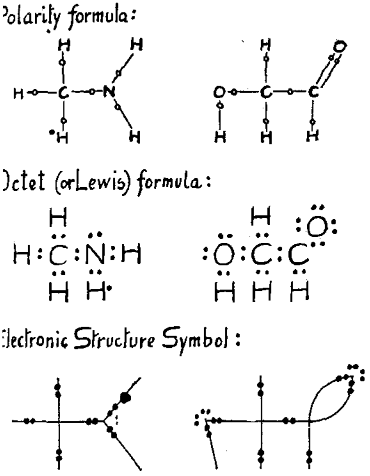

Fig. 3.

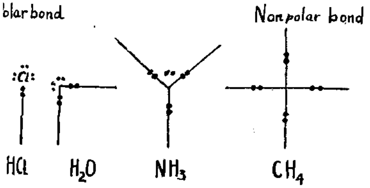

Fig. 4.

Thus carbon-carbon, and carbon-hydrogen bonds are truly non-polar; provided, however, that there are no adjacent radicals or atoms which will disturb tbis polarity. Between non-polar and very polar componnds we may have any number of transitional compounds which will vary slightly in polarity. The extreme of every polar bond is reached when the bond " breaks " and the atoms become ions, that is the complete transfer of one electron from one atom to the other.

The construction of such an electronic structure symbol is perhaps best illustrated by indicating the various steps on a few examples. Let us take ethane, methyl alcohol and acetic acid :

(A) Write the structural formula, Fig. 5a.

(B) Construct the valence skeleton by eliminating the symbols for C,H,O, and N, Fig. 5b.

(C) And obtain thus the structure symbol, Fig. 5c.

(D) Add the valence electrons, Fig. 5d, by placing a dot on each line near the atom so that each line has now two dots corresponding to the pair of electrons, ane from each atom.

(E) Add the unshared electrons, Fig. 5e, so that each atom, except hydrogen, is surrounded by *eight* electrons, which may or may not be on the lines; hence carbon with four lines has all eight electrons, nitrogen with three lines has six electrons shared and received two eletrons outside the line, oxygen with two lines has four electrons in the shared electron pairs and receives two more pairs outside the lines; chlorine with two electrons shared, receives three pairs which are not shared. This figure now shows the proper number of valence electrons, shared and unshared, and corresponds to the Lewis *formula*.

(F) Indicate the shift of the electrons, that is the polarity, by drawing the electrons nearest to the most negative atom, that is the one with the greatest number of unshared electrons, that is in the order Cl > O > N, while C = H. The finished electronic structure symbol is now as shown in *Fig.* 5f.

This final pictnre of the electronic structure should now inlicate that :

(1) In ethane there is a truly non-polar bond; all of the six hydrogens are neither positive or negative radicals or atoms.

(2) In ethyl alcohol the oxygen has drawn the electrons around it, making the alpha-carbon more positive, and the hydrogen of the hydroxyl group likewise positive, that is replaceable by positive radicals or atoms. The hydrogens on the alpha-carbon are slightly negative, replaceable by negative radicals, those on the beta-carbon slightly positive.

(3) In acetic acid the two oxygen atoms have made the carbon still more positive, likewise the hydrogen of the hydroxyl group is very positive, most easily replaced by positive radicals or groups (*e.g.*, esterification, neutralization) while the alpha-carbon has become slightly negative.

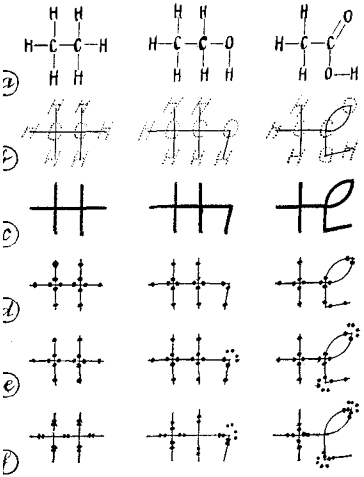

Fig. 5.

In a similar fashion the probable substitution of hydrogen in the benzene ring can be predicted. Fig. 6 shows the neutral benzene molecule. All hydrogens are of equal polarity. If, however, one hydrogen is replaced by a negative radical, Fig. 6b then the second negative radical will select the meta-position, the third negative radical the symmetric position, that is will form substitutes 1, 3—and 1, 3, 5—substitutes. A positive radical, however, will take the ortho-or paraposition, that is form 1,2—or 1, 4 substitutes. If, on the other hand, a hydrogen is replaced by a positive radical, Fig. 6c, the reverse will take place, that is an additional negative radical will choose thethe ortho- or para-postion, and an additional positive radical the meta-position.

The study of electronic structures of organic molecules and the polarity of these compounds is still in its infancy, but the writer believes that this notation will aid in forming some visual concepts of the underlying principles and he invites criticism and discussion.

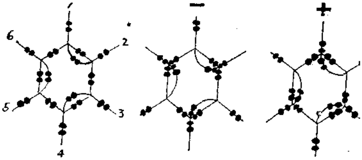

Fig. 6.

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1. *A Chemical Dictionary*, Blakiston's, Phila., Churchill's, London, price 42s., 1929, p. 424.

2. Papers on structure symbols: *Canadian Chem. J.*, 2, p. 135, 1918; *Science*, 48, p. 333, 1918; *Chem. News*, 118, p. 289, 1919; *Ibid.*, 121, p. 85, 1920; *Ibid.*, 136, p. 17, 1928; *Chem. Age* (London), 3, p. 392, 1920; *Chimica e Industria*, 3, p. 449, 1928; *Quimica e Industria*, 6, p. 21, 1929; *J. Am. Pharm. A.*, 9, p. 392, 1920; *Ibid.*, 10, p. 680, 1921; *Ibid.*, 9, p. 948, 1920.

(*From the American Journal of Pharmacy, August*, 1930.)

SIR ERNEST RUTHERFORD A BARON.

NEW YEAR'S HONOUR.

Sir Ernest Rutherford, O.M., chairman of theh Privy Council Advisory Committee for Scientific and Industrial Research, late president of the Royal Society. Sir Ernest was born in New Zealand 59 years ago. His chief contributions to science have heen in connection with radio-active substances and their radiations. He lives at Cambridge.

SUPER-INFLUENCE OF WATER ON PHYSICAL PROPERTIES OF MIXTURES.

By H. H. STEPHENSON.

A 50/50 mixture of alcohol and water is 2.5 per cent. heavier than the average density of alcohol and water. A 50/50 mixture of sulphuric acid and water is 1.4 per cent. lighter than the average of sulphuric acid and water: (the difference would be still more if H_2SO_4 were not abnormal in having its maximum density at 98.5 per cent. instead of at 100 per cent.)

These observations illustrate a general principle which is so easy to remember that one wonders that it has not found its way into the text-books. It is: *Whenver a mixture of water and another liquid de-*

viates in physical property from the average of its components, it deviates in the direction of the water component. Water pulls more than its weight in influencing physical properties. Water is heavier than alcohol and lighter than sulphuric acid, and the deviation corresponds. The proviso should be made that the other liquid is a true liquid and is perfectly miscible with water. Nitric and hydrochloric acids, for example, are solutions of gases, and acetic acid is a solution of a solid.

Examples of this principle are as follows. The temperature is 15°C.

	Liquid	*Water*	*Average*	*Actual 50/50*
Density :				
Methyl alcohol	0.7964	1.00	0.8982	0.9197
Ethyl alcohol	0.7935	1.00	0.8967	0.919
Glycerine	1.2650	1.00	1.1325	1.1290
H_2SO_4	1.8385	1.00	1.4192	1.399
Refractive Index :				
Glycerine	1.4742	1.3330	1.4036	1.3996
Boiling Point :				
Glycerine	290°C	100°C	195°C	106°C
H_2SO_4	>295°C	100°C	200°C	124°C

If this principle is confirmed, a number of questions suggest themselves :

(1) Why has water this property. We live in an aqueous world. Perhaps there was some process of survival of the fittest.

(2) Is there another liquid which is similarly superior to all other liquids except water?

(3) Is there a series of such liquids? What is the principle underlying it?

(4) Is there any gas which can act in the same way to other gases?

SEVENTY YEARS AGO.
(From the Chemical News, Feb. 18, 1860)

OXIDES OF CERIUM, AND THE YELLOW AND RED SULPHATES.

Cerium, according to Rammelsberg', may be obtained from lanthanum and didymium perfectly pure by the process of M. Hermann, which consists in precipitating the subsulphate of ceroso-ceric oxide by means of water.

The *protoxide of cerium*, CeO, is obtained by heating the carbonate or oxalate in a current of pure hydrogen. It is a bluish-grey powder, which, exposed to air, becomes cerosoceric oxide, and takes a yellow colour : its hydrate is white.

Ceroso-ceric oxide, $CeO.Ce_2O_3$, is procured by calcining in the air either the carbonate, oxalate, or cerous nitrate. It is yellowish-white, with a slightly red tint, becoming yellow for a time when heated, and only dissolves in concentrated sulphuric acid, forming an orange coloured liquid. Hydrogen reduces it to cerous oxide. Neither calcination in oxygen nor fusion with nitre will oxidise it further. Its hydrate contains 3 atoms of water, and is formed when chlorine is passed into a solution of potash, holding in solution the hydrate of cerous oxide.

From the orange solution of ceroso-ceric oxide in sulphuric acid the following salts may be obtained :

The *brown-red or orange sulphate* (*a*), crystallised in hexagonal prisms, which contains $3(CeO.SO_3) + Ce_2O_3 3SO_3 + 18\ HO$. This salt is decomposed by water, separating into a sulphur-yellow basic salt, and giving with potash a greyish-red precipitate, which contains $3CeO + Ce_2O_3$, which becomes yellow in the air, changing into $CeO.Ce_2O_3$, and attracting a small quantity of carbonic acid.

A *yellow sulphate* (*b*) irregularly crystallised, which contains $CeO.SO_3 + Ce_2O_3\ 3SO_3 + 8aq$. With water it behaves like salt (*a*).

The *basic ceroso-ceric sulphate*, formed by the action of water on the preceding salts, constitutes a clear yellow precipitate, whose composition may be represented by the formula

$$2(CeO.SO_3) + 2(Ce_2O_3)SO_3 + 6\ aq.$$

Calcined at a bright red heat all these sulphates leave ceroso-ceric oxide. When solutions of the red-brown ceroso-ceric sulphate (*a*) and sulphate of potash are mixed a yellow precipitate is formed, constituting a mixture of double salts.

We regret to record the death recently of Dr. Z. Strakaty, the distinguished Czechoslovak chemical engineer associated with the cement industry, at the comparatively early age of 55.

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THE IONIC STATE OF THE INTRUSIVE STRATA.

R. Saxon, B.Sc., F.C.S., Mem. Soc. Chem. Ind., Mem. Amer. Chem. Soc.

The best known of the intrusive strata in the periodic table is that comprising Vanadium, Chromium, Iron, Cobalt, Nickel, swinging round to copper. Its salts are coloured, and though occupying the electronegative part of the table the elements are positive, or rather more positive than their congeners. Whatever acid qualities their higher oxides have that quality decreases as we approach the copper end. The affinity for oxygen decreases at the same time. The same tendency is seen in the stratum Columbium, Molybdenum, Ruthenium Rhodium, Palladium, Gold. The third stratum shows the same, with Tungsten, Osmium, Iridium, Platinum. The reaction to coloured light is varied with varying presence of other elements. They seem to have a monopoly of colour. Salts of other elements are white, with a few exceptions in polysulphides, polyoxides, etc.

The most interesting of the first stratum is copper. It is a peculiar *red* usually, *iron red* in fine powder the complementary colour to cuprion as when deposited on a cathode in copper salt solution it looks just lige steel, *green* by transmitted light as may be seen when depositing by means of a strong light, and *purple* in the colloid or ionic state. If a mixture of white glue, and silver sand cleaned of tangible iron, be melted and poured to form a septum at the bottom of a U tube, the anode portion may be filled with copper chloride solution and the other with common salt solution. The gel at the bottom of the U tube acts as a finely porous pot if previously firmly set. The liquids should be allowed to penetrate the gel so that all ebullition ceases. When the current is switched on independent action takes place within the gel accompanied by independent ebullition of gas, oxygen and chlorine at the anode, and white cuprous hydroxide at the cathode along with green copper chloride away from the cathode at the cathode compartment. This green gives way to a beautifnl azure blue, purer than that of copper salts, deprived of its green as is evident to the eye, and the spectroscope. If the current is too strong the heat will melt the gel with disaster. If too weak, no indenpendent reaction will be observed in the gel, where as the experiment goes on the gel loses its dissolved water, the resistance increases and sparking becomes general within the gel. So the lighting current is used, DC. 220 volts, and a resistance box inserted to prevent melting. Generally 50 ohms works beautifully. Copper sulphate may be used when *Copper Chloride* appears in the cathode limb. If the resistance is high enough in the box the cathode limb shows no white cuprous hydroxide, but the liquid from takes on a purple tint which spreads round the cathode, and *nowhere else*, resting on a column of colourless common salt solution. Whenever copper is deposited in bulk it pentrates the gel. The purple becomes darker as time goes on affording characteristic absorption bands but refuses to drop below the level of the cathode end. The purple refuses to become blue, but blue cupron will eventually become purple.

Cobalt salts act in a precisely similar way but the cobaltion at first is deep pink and the hydroxide, the general result of electrolysis in water of practically all salts, is pink also. Independent action and sparking goes on in the gel. The final state of the cobaltion with prolonged electrolysis is purple. Whether the bands are the same those of copper has not been ascertained, as the action is slower than with copper. Again the cobaltion purple rests on a pillar of colourless solution. Nickel so far has not yielded this purple. It would appear that cuprion, etc., are deliveries from the gel for it is the chloride found down there in using the sulphate and *not the percolated copper sulphate*. This chloride becomes white when the purple colour begins to assert itself.

The electrodes are of coiled Platinum Foil.

NEW DESIGN OF EVAPORATOR.

Continuous Operation with Mechanical Removal of Deposit.

(By a Well Known Engineer.)

Of great interest from the chemical engineering point of view is a new patent evaporator for sea water that has recently been placed on the market by Messrs. Clarke Chapman and Co., Ltd., of Gateshead-on-Tyne, (English Patent) for marine and general use, and the general principle would seem to have interesting possibilities also in the chemical industries.

The ordinary types of salt water evaporator, consisting of a closed vessel with steam heated coils, has the inherent disadvantage of the formation of hard deposits of scale on the outside of the coils, which both reduces the efficiency to a serious degree, and necessitates frequent laborious

hand cleaning. In the new design this has now at last been eliminated, the deposited scale removed continuously by means of a series of scrapers and taken out from the bottom at intervals in the form of a sludge. Consequently a continuously high rate of evaporation is obtained, the apparatus being available in standard sizes of 2-100 tons of salt water per 24 hour capacity.

Essentially the "Clarke Chapman" evaporator is a vertical, cylindrical, evaporator vessel, with steam heating elements consisting of a whole series of shallow, horizontal, hollow, bronze discs, instead of tubes, immerced in the salt water, almost as wide in diameter as the cylinder, attached close together one above the other to a central hollow shaft, which revolves slowly, driven by a small electric motor on the top. The live steam enters at this point and passes down the shaft and through all the hollow bronze discs, which are thereby highly heated, causing the salt water to boil continuously. The very hot condensed water from the steam is discharged from the bottom of the shaft and the vapour from the evaporating brine, maintained at a constant level, passes out from the top through a cleaner to the condensers.

The scale tends to deposit, because of gravity, in the lower part of the evaporator, on the flat surface of the hollow discs, and there is included a series of stationary self-adjusting horizontal scrapers, with a knife edge, attached to the side of the cylinder, projecting between each of the slowly rotating discs and just touching the surface. In this way the scale is scraped off continuously and no hard deposit can form, the metal surfaces being always kept clean and operating at the full heat transfer capacity, and therefore evaporative output.

The workmanship throughout is of the usual high grade Clarke Chapmau quality, with efficient lagging and use of special sea water resisting bronze for the hollow shaft and the evaporator discs. Also the drive of the latter, which only takes 6-7 h.p. for the largest sizes, is by means of noiseless worm and spur gearing, running in an oil bath, while the central, hollow shaft is carried in a thrust bearing also running oil, on the top of the evaporator. Further the self-adjusting scrapers are easily removable, the deposited scale is run out as a sludge from the bottom at regular intervals, and before condensation the vapour is thoroughly drained and cleaned, the arrangements consisting of baffles as well as porcelain Raschig rings for filtering fixed between the evaporator and the condenser.

GENERAL NOTES

SOCIETY OF CHEMICAL INDUSTRY MEDAL.

Honour for Dr. Herbert Levinstein.

Dr. Herbert Levinstein, the English chemist, has been awarded the medal of the Society of Chemical Industry.

Making the announcement the *Journal* of the Society states :— " Dr. Levinstein's undoubted claim to the Society's Medal is his capable and valuable work in the dyestuff industry. Already occupying an important position in the indnstry during the lifetime of his father, Mr. Ivan Levinstein, also a president of the Society, when the latter died in 1916, Dr. Levinstein shouldered the heavy burden of work and responsibility then confronting him. These were strenuous times, for the makers of dyestuffs were not only turning out dyestuffs but munitions of war as well, in spite of obstacles that five years previously would have been considered insuperable. This has been his greatest and finest piece of work, his 20 years of devotion to the dyestuff industry, and it is this which has caused the Society to confer upon him the distinction of its medal."

The medal is awarded not more frequently than once every two years for " conspicuous services to applied chemistry by research, discovery, invention, or improvement." Dr. Herbert Levinstein, who is the eighteenth recipient of the honour, during the War period did much valuable work on the Chemical Warfare Committee, aud became known as one of the greatest poison gas experts on the Allied side. He is a past-president of the Society of Chemical Industry, and also of the Society of Dyers and Colourists, and the British Association of Chemists. Among previous British holders of the medal have been Dr. Ludwik Mond, Sir William Crookes, Sir James Dewar, and Sir Richard Threlfall.

PRAGUE SAMPLES FAIR.

March 22-29, 1931.

Nearly all the space available for the Prague Samples Fair, next spring, has been allotted and the catalogues (in several languages) have already gone to press. The fair will open this year on March 22 and will continue until the 29th. A part of the large Fair Palace is now open as permanent showrooms for exhibitors.

BOARD OF TRADE ANNOUNCEMENTS.

KEY INDUSTRIES.

A representation has been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding acid propionic.

Section 10 (5) of the Finance Act, 1926, is as follows:—

"The Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act ,1921, as amended by this Act, for such period as may be specified in the order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that there is no reasonable probability that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Any communication should be addressed to the Principal Asisstant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, S.W.1, within one month from the date of this notice.

EXEMPTIONS FROM KEY INDUSTRIES DUTY.

The Treasury have made an Order under Section 10 (5) of the Finance Act, 1926, continuing the exemption from duty of acid hydrocyanic anhydrous till 30th June, 1931.

The Treasury Order will shortly be published by the Stationery Office.

TENDER FOR DISINFECTANT FOR EGYPT.

The Commercial Secretary to the Residency, Egypt, reports that the Egyptian Department of Public Health is calling for tenders, to be presented in Cairo by the 3rd March 1931, for the supply of disinfectants for commercial and general purposes required during the year ending 30th April, 1932.

Firms desirous of offering disinfectants of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S..W.1. Reference B.X. 6937 should be quoted.

EGYPT. TENDER FOR DRIED AND CONDENSED MILK.

The Commercial Secretary to the Residency, Egypt, reports that the Egyptian Department of Public Health is calling for tenders, to be presented in Cairo by the 28th February, 1931, for the supply of 2270 kilos. of dried milk for infants, and 5,000 kilos. of unsweetened condensed milk.

Firms desirous of offering British products can obtain further particulars of this call for tenders upon appliation to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 6934 should be quoted.

CARNEGIE INSTITUTE OF TECHNOLOGY.

SCHENLEY PARK, PITTSBURGH.

A third international conference on bituminous coal will be held at the Carnegie Institute of Technology in Pittsburgh, Park, in November, 1931, accordng to a recent announcement of Dr. Thomas S. Baker, president of the Institute of Technology and organizer of the first two congresses.

Prominent fuel technologists from all parts of the world will be invited to attend the conference. In connection with organization of the meeting, Dr. Baker will make a trip to Europe this month to invite prominent scientists to speak at the congress. He will visit Paris first for a period of several weeks, going from there to London, Berlin and other European capitals. He will remain abroad until the middle of February.

The purpose of the conference, Dr. Baker announced, will be similar to that of the meetings held in 1926 and 1928 : to present for discussion the results of recent studies in coal. Particular attention will be paid to the economics of the new methods and processes that are being evolved, he indicated.

The programme will include papers on carbonization, liquefaction and gasification of coal; by-products of coal; the mechanism of combustion; cleaning of coal and its preparation for the market; pulverized fuel; power plants, and domestic heating. The discussions will be confined to coal above ground. Beginning at the mouth of the mine, however, practically every phase of distribution and consumption will be treated by outstanding authorities in the several fields.

Prominent American men of affairs will will assist Dr. Baker in the organization of the conference. The advisory board, which has just been announced by the organizer of the conference, will consist of Mr. James A. Farrell, president of the United States

Steel Corporation; Mr. John Hays Hammond, prominent mining engineer; Mr. Samuel Insull, public utilities magnate; Mr. Frank B. Jewett, president of the Bell Telephone Laboratories, Inc.; Hon. A. W. Mellon, secretary of the United States Treasury and capitalist; Mr. F. A. Merrick, president of the Westinghouse Electric and Manufacturing Company; Mr. August G. Pratt, president of the Babcock and Wilcox Company; Mr. H. B. Rust, president of the Koppers Company; Mr. Matthew S. Sloan, president of the New York Edison Company; and Mr. W. C. Teagle, president of the Standard Oil Company of New Jersey.

Announcement of this thord world meeting comes in logical sequence to the previous congresses. The first conference was organised by President Baker in 1926 for the purpose of finding new uses for bituminous coal. This meeting, although the first of its kind to be held, attracted 1,700 scientists from thirteen countries. Two years later followed the second congress which was broader in its scope, including discussions on pulverised fuel, low temperature carbonisation of coal, rubber from coal, the hydrogenation of coal, and by-product nitrogen. Speakers during the two conferences have included such scientists as Georges Claude, Dr. Friedrich Bergius, Prof. Franz Fischer, Dr. C. H. Lander, Dr. H. Lessing, General Georges Patart, Dr. Fritz Hofmann, and Dr. Karl Krauch. Papers of numerous other fuel technologists were presented at the meetings.

The published proceedings of the two conferences have been enthusiastically received, and they are now considered standard reference books on modern fuel technology.

"The condition of the coal industry during the past few years can hardly be called healthy," President Baker said, "and the current business let-down has brought extreme depression to ths basic world industry. We hope that as a result of the dscussions held we may be of assistance in uncovering new processes which may help it on the road to recovery."

SULPHUR IN THE AIR.

Decay of Buildings.

It is proposed to erect a large Electricity generating station at Fulham, London, to which has been offered opposition. The authorities have been holding an inquiry into the subject at which expert evidence was given, on December 17.

Mr. J. E. Singleton, K.C. (for the London County Council), was permitted to interpose the evidence of Sir Frank Bames, F.R.I.B.A., who stated that the damage due to smoke pollution of the atmosphere had been increasing in the past few years. He submitted photographs which showed that new Portland stone in Whitehall had definitely decayed ¼in. in 14 years, and that the lettering on a country War memorial near Stafford had been entirely obliterated in certain parts during the period between 1921 and 1927. The damage was the definite result of the deposit of sulphuric acid on the stone. The problem of the danger to the Houses of Parliament was complicated by the geological condition of the stone, which was a magnesia limestone. He could submit photographs of damage to the Houses of Parliament which he hoped would horrify even the optimistic members concerned with the inquiry. His estimate over a period of years has been that it would cost a million sterling to put the Houses of Parliament in a reasonable repair.

Counsel.- Was that damage due to this particular defect in the stone resulting from sulphuric acid?—Yes.

Dealing with the ravages of atmospheric impurities on buildings all over the country, Sir Frank Baines said that he had found evidence of the action of sulphur far removed from industrial centres. In the valleys of Yorkshire there were ancient buildings of the twelfth and thirteenth centuries. Those buildings had survived apparently, without decay or destruction for a long period, and now they were really perishing at a fast rate. One could take hold of ornaments around the windows and snap them off in the band. This decay was entirely due to the sulphur impurities in the atmosphere.

A Loss of £55,000,000.

Questioned as to the monetary value of the damage to buildings in general in this country over a period of years, he said that, taking a quarter of a century, the exeess cost to the nation as a whole was from £55,000,000 to £60,000,000 as the result of atmospheric impurities.

Asked what was the source of damage to the Houses of Parliament, the witness said it was difficult to say what was the specific, actual source of damage, but a good deal of it was due to the proximity of the Lots-road power station. The damage was not limited to Portland stone. It extended to other kinds of stone. On buildings erected partly in Portlaud stone damage was done by calcium sulphate being carried down by

rain from the Portland stone to other portions of the buildings. So far as he know there was no preservative which would inhibit the effect of atmospheric pollution of buildings.

In answer to Mr. Tyldesley Jones, K.C. (for the Fulham Borough Council), the witness said the buildings in the valleys of Yorkshire to which he had referred were Byland and Rievaulx Abbeys.

MERCURY SWITCHES.

The use of mercury switches for making and breaking electrical circuits is, of course, by no means new, in fact, our oldest methods of establishing circuits in the early days of experimental physics embodied the use of mercury, usually contained in cups or boles in an insulating material. Of course, this crude method was suitable for experimental work only, and the surfaces of the mercury had to be cleaned when it became oxidised. The use of mercury switches for technical and industrial purposes, however, calls for absolute reliability, the elimination of all cleaning and the possibility of making contact with minimum of energy, either with hand or mechanically operated. It was soon found necessary to enclose the mercury into sealed vessels of glass or other insulating material, although even then it was found that oxidisation took place with time, rendering contact between the metallic electrodes and the mercury far from perfect.

With the ever-increasing use of such switches it became imperative to do away with these difficulties, and complete success was obtained by giving careful attention to 2 or 8 important points.

Firstly, we have to make certain that the contact is always established between mercury and mercury, and not between mercury and metal, since in the latter case when dealing with heavier currents and voltages an arc might be established which would lead to the melting of the electrode and leakage at the sealing point. By so arranging the switch that the leading in electrodes are contained in pockets which are always covered with mercury, this difficulty cannot arise. As the choice of the metal which can be immersed in mercury is very limited and since platinum electrodes for heavier currents are out of the question on account of price, it has become usual to make electrodes of some ferrous material which for better conductivity is platinised.

Secondly, the quality of the glass for the tube has to be carefully selected since the tube walls are heated by the opening spark and might crack in time. All our tubes are drawn from hard Jena glass which shows considerable resistivity to mechanical and heat breakage, but for heavy and continuous work, special types of switches have been developed in which a separate spark protection is embodied in the form of internal troughs or inner tubes of hard glass, ceramic material, or quarts. The greatest care is taken to ensure that the electrodes should be perfectly sealed in and according to the glass employed for the tube, special alloys are used for the purpose. After evacuation the tubes are heated to the softening point, and then gradually cooled for many hours in order to thoroughly remove all internal stresses. Connecting leads are made from specially flexible stranded copper wire of the finest gauge, and insulation may be provided by means of glass beads, silk or ceramic beads.

Thirdly, in order to prevent all oxidisation and to keep the mercury perfectly clean, we use vacuum-distilled mercury and a chemically-pure reducing gas for filling the tubes after evacuation to such a pressure as to ensure prompt extinction of the spark.

The new list of mercury switches and relays just issued by Isenthal and Co., Ltd., Duncan Works, Victoria Road, North Acton, is probably the most complete that has ever been published.

TRADE AND INDUSTRY.

Iron and Steel Production in November.

The National Federation of Iron and Steel Manufacturers reports that 384,100 tons of pig iron were produced in November, as compared with 415,000 tons in October, 631,400 tons in November, 1929, and a monthly average of 855,000 tons in 1913.

Furnaces in blast at the end of Novembeh numbered 92, a decrease of four as compared with the beginning of the month.

The November output of pig iron included 107,500 tons of hematite, 148,600 tons of basic, 102,500 tons of foundry, and 18,000 tons of forge pig iron.

The production of steel ingots and castings in November amounted to 433,700 tons, compared with 512,500 tons in October, 815,000 tons in November, 1929, an da monthly average of 638,600 tons in 1913.

HOTTEST SPOT ON EARTH HITS 900,000 DEGREES.

Ninety degrees in the shade, Fahrenheit, (says *Popular Science Monthly*) makes an uncomfortably hot day. At 212 degrees water boils, and no human being can live in boiling water. What chance would one have, then, if hit by the hottest temperature ever developed on earth—one of 900,000 degrees? This intense heat, far greater than that of the sun at the surface, has been produced between the electrodes of an electric arc in a vacuum tube by R. Tanberg of the Research Laboratory of the Westinghouse Electric and Manufacturing Company. The heat is determined by the action of gaseous atoms of metal vaporized from the electrodes. No thermometer could measure such heat, which probably exceeds anything outside the centre of some of the biggest stars. In the old-fashioned arc lighter there was a spot in the end of the carbon where the temperature rose to 10,000 degrees, but nothing approaching the tremendous heat measured by Tanberg has hitherto been found on earth.

FUEL RESEARCH IN CANADA.

The Secretary, Office of the High Commissioner for Canada in London has received from the Mines Branch of the Dominion Department of Mines at Ottawa copies of Report No. 712 dealing with Investigatious of Fuels and Fuel Testing during the year 1928.

The Report in question contains a general view of investigations by Messrs. B. F. Haanel and R. E. Gilmore, together with the following special studies by members of the Fuel Research Staff :—

Report of preliminary carbonization and briquetting tests on lignite from northern Ontario, by R. A. Strong.

Report on oil-shale from Pictou County, Nova Scotia, by A. A. Swinnerton.

Laboratory Notes, by J. H. H. Nicolls :

1. *Under-water storage of Saskatchewan* Lignite.
2. *Effects of prolonged weathering on the friabilities of certain coals.*
3. *Observations concerning organic and other forms of sulphur in coals containing large amounts of sulphur.*

Analyses of coals and other solid fuels, compiled by J. H. H. Nicolls and C. B. Mohr.

Gasoline Survey for 1928, by P. V. Rosewarne and R. J. Offord.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Papers read on Thursday, December 18.

1-ω-Halogenoalkylisoquinolines and their Derivatives. By R. Child and F. L. Pyman.

In the course of attempts to synthesise substances having amœbicidal properties, a compound has been prepared from δ-chlorovalero-β-veratrylethylamide through 6 : 7-dimethoxy-1-δ-chlorobutyl-3 : 4-dihydro*iso*-quinoline, and a quaternary chloride.

Chloroaceto-β-veratrylethylamide was readily converted into 6 : 7-dimethoxy-1-β-amino-ethyltetrahydro*iso*quinoline was prepared through 6 : 7-dimethoxy-1-cyanomethyl-3 : 4-dihydro*iso*quinoline.

A Synthesis of Hydrastine. By E. Hope, F. L. Pyman, F. G. P. Remfry, and R. Robinson.

Condensation of hydrastinine and nitromeconine in boilng alcoholic solution affords anhydrohydrastinine-nitromeconine in good yield. This base may be a mixture of two isomerides, and on reduction the aminohydrastines *a* and *b* are obtained.

On diazotisation, and reduction of the diazonium salts, the corresponding hydrazinohydrastines *a* and *b* were derived, and on oxidation by means of cupric salts the latter bases furnished the hydrastines *a* and *b* respectively. These substances are doubtless the optically inactive forms of the α- and β-hydrastines, the existence of which is required by ordinary stereochemical theory, and one of them should be the racemic modification of the natural alkaloid.

The Mechanism of, and Constitutional Factors Controlling, the Hydrolysis of Carboxylic Esters. Part V. Influence of Alkyl Groups on Hydrolytic Stability Maxima. By C. M. Groocock, C. K. Ingold, A. Jackson, and M. I. Kelly.

Consideration is given to the observed hydrolytic stability maxima of (1) alkyl glycerates with variable alkyl, R, and of (2) *O*-acyl*iso*propylideneglycerols with variable acyl, RCO, and also to stability maxima calculated from recorded data relating to (3) alkyl acetates with variable alkyl R. If the *p*H of the maximum for each ester be

plotted against the corresponding pH for the two remaining esters having the same R, the points lie on three straight lines. Analogous graphical comparisons of the above data on ester hydrolysis with the velocities of nuclear halogenation (Bradfield and Jones) of aromatic ethers $R.O.C_6H_4R'$ (R' fixed) yield a further system of straight lines. Comment is passed on the conditions under which this type of relationship may be expected to be exhibited by comparisons of the kinetics of different reactions or of the same reaction applied to different series of compounds.

The Mechanism of, and Constitutional Factors Controlling the Hydrolysis of Carboxylic Esters. Part VI. Speeds of Consecutive Stages of Saponification of Some Normal Dicarboxylic Esters. By C. K. INGOLD.

New data of the nature indicated in the title, together with recorded results, are used to calculate the apparent distances between the carboxyl groups of esters of the complete series of normal dibasic acids up to sebacic acid. The distances increase continuously with the number of methylene groups, and are in fairly good agreement with those calculated from the ionic equilibria of acids. Allusion is made to the nature of the approximations and errors inherent in the simple form of theory used.

Forthcoming Events.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21 ALBEMARLE STREET, W.1.

CHRISTMAS JUVENILE LECTURES.
at 3 p.m.

"The Electric Spark." By Prof. A. M. Tyndall, D.Sc., M.R.I.

Saturday, January 10, 1931, at 3 p.m.—VI. "Large sparks."

A "Tesla" coil produces high voltage and gives sparks and discharges with special properties. Much longer sparks, large generators giving one or more million volts. Nature provides the greatest sparks many feet in length, can be obtained from of all in lightning. Electric charges may be generated in clouds in enormous quantities. The rain falling from them is electrified. The study of lightning flashes is now being carried out in various ways. Even the atmospherics which trouble us in broadcasting give useful information. The problem of protecting buildings from lightning presents special difficulties. Faraday carried out a wonderful experiment with a large cage in the theatre of the Royal Institution. It can be shewn that such a cage will give to anyone inside it complete protection from electric sparks.

MINERALOGICAL SOCIETY.

Tuesday, January 13, at 5.30 p.m.—General Meeting. The following papers will be read :—

"On a Soda-Margarite from the Postmasburg District, South Africa." By Dr. F. Coles Phillips.

"On the Distinction of Analcime from Leucite in Rocks by X-ray Methods." By F. A. Bannister.

"On a Chemical, Optical and X-ray Study of Nepheline and Kaliophilite (with Chemical Analyses by Mr. M. H. Hey)." By F. A. Bannister.

SOCIETY OF DYERS AND COLOURISTS.

At the joint meeting with the Manchester Sections of the Society of Chemical Industry and the Oil and Colour Chemists' Association at 7 p.m., on Friday, January 9, at 36, George Street, Manchester, a paper on "Human Factors in Colour Judgment" will be read by W. O. D. Pierce, Esq.

MANCHESTER CHEMICAL SOCIETIES.

Friday, January 9, at 7 p.m., in the Lit. and Phil. Society, George Street, Oil and Colour Chemists' Association, Society of Dyers and Colourists, and Society of Chemical Industry (Joint).—"Human Factors in Colour Judgment." By W. O. D. Pierce.

THE PHYSICAL SOCIETY.

Friday, January 16, at 5 p.m., at the Imperial College of Science, Imperial Institute Road, South Kensington.—Ordinary Meeting.

THE INSTITUTE OF METALS.

NORTH EAST COAST LOCAL SECTION.

Tuesday, January 13, at 7.30 p.m., in the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne.—"Copper-Silicon Alloys." By W. B. Goudielock.

An economic investigation into the Tobacco Industry of the Western Transvaal has been conducted by the South African Department of Agriculture and the findings have been published in *Bulletin* No. 89, by W. G. Pretories, B. A., M.Sc. (Pages 84, price 3d.)

The bulletin contains a description, as well as an analysis of the economic factors, of South Africa's most important tobacco area. In 1928 prospects of tobacco growing were not too favourable but circumstances have improved conditions and the the industry may soon establish itself firmly in the Union.

A lecture on "The Situation in England" was given recently to the English-Speaking Club at Bratislava, Czechoslovakia, by Mr. Charles Benyovsky, a distinguished journalist and editor of the *Grenzbote*. Mr. Benyovsky had just returned to Bratislava after au extended tour through Italy, France, England, Belgium and Germany. He referred to the way in which present conditions and difficulties in England were being met and declared himself optimistic concerning the future.

As a result of research work in the Haidarkan mercury and antimony deposits in the Fergan it has been found that these deposits are the richest in the U.S.S.R. It has been estimated that there are 10,000 tons of these minerals on an extensive area.

Besides mercury the Haidarkan district has large deposits of antimony (a mineral used in metallurgy) as well as extensive layers of fluorspar. The Haidarkan layers are especially profitable since the mineral is near the surface and can be extracted easily.

The discovery of the Haidarkan layers gives the U.S.S.R. first place in the world for deposits of mercury.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

38,084.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of maleic acid. December 17.

38,437.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of anthraquinone and homologues. December 20.

38,463.—I. G. Farbenindustrie Akt.-Ges. —Recovery of nitrogen—containing organic substances. December 20.

Specifications Published.

339,589.—Bangham, P.F., Hooley, L. J. Thomas, J., and Scottish Dyes, Ltd. —Anthraquinone derivatives.

339,717.—Heerdt—Lingler Ges. — Storing and transporting hydrocyanic acid.

Priuted copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

336,960.—Aliphatic anhydrides. Dreyfus, M., 23, Hanover Square, London.

Acetic and other aliphatic anhydrides are made by heating the vapour of the acid in contact with an oxide or acid of arsenic or antimony or a salt of such acid. The bodies mentioned are the trioxide and pentoxide of arsenic and antimony and arsenates and antimonates such as sodium, potassium, calcium and magnesium arsenates, sodium and potassium antimonates or mixtures of such substances. The acid vapour may be passed through a fireclay, silica, copper, or tube containing the catalyst, which may be in solid or liquid state when non-volatile, and may be supported upon or mixed with filling material such as pumice, kieselguhr, etc., carborundum in the forms of balls or pieces. When the catalyst is xolatile, a mixture of the catalyst (for instance arsenic

trioxide) and the acid vapour may be passed through heated tubes etc., which may contain one of the non-volatile catalysts or a filling material; or a mixture of the volatile catalyst and the liquid acid may be injected into a hot reaction zone. The reaction may be effected under ordinary,

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The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

SUPERSAN.

517,602.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Boots Pure Drug Co., Ltd., 37, Station Street, Nottingham. December 24. (Associated).

ENZENA.

518,170.—Chemical substances used for agricultural and horticutural, veterinary and sanitary purposes.—B. C. Tipper and Son, Ltd., 43 to 45, Homer Street, Balsall Heath, Birmingham. December 24.

518,014.—A circular label device and the word NUST coloured according to heraldic convention. Paints and chemical substances for use in the manufacture of paints.—Nor—rust Liquid Lead Co., Iddesleight House, Caxton Street, London, S.W.1. December 24.

BINDING CASES.

Handsome Red Cloth (stiff) Binding Cases, Gold-lettered, for Binding the *Chemical News*, can now be had from the Office, Merton House, Salisbury Square, London, E.C.4., price 3/-; post free, 3/8

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or *How to Reason Correctly*. By J. E. Roscoe, M.A., Oxon.

An invaluable Book for all who desire to excel as speakers and who wish to reason convincingly.

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This large Volume contains a detailed Index to the first 100 Volumes of the *Chemical News*, and will be found of great value to all interested in Chemical Engineering, Electrical and General Scientific subjects. *It has been compiled with great care*, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

CONFESSIONS OF GREAT SOULS.

By the Rev. J. E. Roscoe, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

The work is handsomely bound, and has a copious index for easy reference, and the work, containing as it does, the gems of thought on some of the world's greatest thinkers, will form an acquisition to any library.

By post, 5/- net.

THE CHEMICAL NEWS

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THE ISOTOPES OF POTASSIUM : THEIR ASSOCIATION WITH PLANT LIFE.

By J. G. F. DRUCE.

A preliminary account of some experiments carried out in 1929 to investigate the possible separation of the isotopes of potassium biologically was given by Loring and Druce in *The Chemical News*, 1930, CXL, 34-6.

Potassium Chloride, obtained from the ashes of potato stalks was found to obtain more of the higher and more radioactive isotope (41) than is contained in the ordinary, mineral salt, KCl.

These experiments have been repeated and extended this year and they confirm the results already announced.

About 60 lbs. of ash fom potato stalks (haulms), *i.e.*, about twice the amount used last year, were extracted with a minimum of cold water, on the counter-current principle and yielded about 6 litres of a straw-coloured solution of potassium carbonate. No attempt was made to extract all the K from the ash. This was neutralised with 4 N. HCl giving a solution from which some crystals separated on standing. The filtrate from these was treated with HCl gas which precipitated, in all, nearly three lbs. of crude, slightly impure, potassium chloride. A further quantity of crude potassium chloride was obtained from the filtrate by further treatment but was not examined during these experiments. The final filtrates, however, were evaporated and the residues examined as described below.

From the first crop of potassium chloride precipitated with HCl gas about 150 gr. of purified KCl was obtained by repeated crys-

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tallisations (first and last fractions were always rejected) from hot water and precipitation from cold aqueous solution with HCl gas. The salt, after two final re-crystallisations from water, was drained, dried and heated to fusion point.

This salt showed no signs of any metallic impurity when examined spectroscopically.

No sulphate, phosphate, other halogen salt or indeed any impurity could be detected by ordinary analytical methods.

Analyses of KCl from Potato Stalk Ashes.

(1) 2.8632 gr. KCl gave 3.3350 gr. K_2SO_4 when carefully acted upon with very slight excess of sulphuric acid in a platinum crucible and then subsequently fused for some time (about 30 minutes) and he-heated to constant weight.

Assuming Cl = 35.46 and S = 32.06

$$2.8632(x+48.03)=3.3350(x+35.46)$$
$$2.8632x+137.5=3.3350x+118.2$$
$$.4718x=19.3$$
$$x=40.8$$

Thus the atomic weight of potassium is here 40.8.

(2) 2.3046 gr. KCl gave 2.6854 gr. K_2SO_4. K = 40.06.

(3) Using burette, pipette and weights carefully calibrated by Dr. E. J. Weeks, M.A., an average reading of 10.015 c.c. of .1852 Normal KCl solution took 9.550 c.c. of .1939 Normal $AgNO_3$ for complete precipitation. The KCl was obtained by dissolving 1.3980 gr. in water to make 99.985 c.c. of solution.

The KCl is thus $\frac{9.55}{10.015}$ of .1939 Normal in respect of chlorine and 99.985 c.c. contain $\frac{9.55}{10.015}$ of .1939 of 3.546 of .99985 gr. Cl, *i.e.*, .6556 gr. Cl.

Thus, .6556 gr. Cl combine with .7424 gr. K and 35.46 gr. Cl combine with 40.2 gr. K.

From these results it would seem that there is a definite enrichment of the higher isotope of potassium by the plant.

Non-Living Wood.

In order to study the influence of the *living* plant on the potassium contained in its tissues it was considered of interest to examine the ashes obtained from dead wood and also from seeds, since it is conceivable that germination might ,in some way, be associated with the radioactivity of the plant.

About 15 kilograms of ashes from dead coniferous wood was treated as above with water and HCl; the KCl obtained from the neutralisation of the extracted K_2CO_3 was recrystallised as before to yield about 6 gr. of purified KCl.

On analysis

.8882 gr. KCl gave 1.7083 gr. AgCl containing .4225 gr. Cl.

therefore

.4225 gr. Cl are combined with .4657 gr. K and 35.46 gr. Cl are comgined with 39.11 gr. K.

This result seems to indicate that in non-living plant tissue there is no longer any accumulation of the higher isotope.

Seeds.

The amount of ashes from seeds that I have been able to examine has not been, in my opinion, adequate to enable me to include the results in the present paper. From a preliminary examination of the ash from lupine seeds it would see mthat plants do effect a bioligical enrichment of the higher isotope of potassium (*vide* Loring and Druce, *loc. cit.*)

Thus,

.1907 gr. KCl gave .3590 gr. AgCl equivalent to .0888 gr. Cl, and

0.0888 gr. Cl were combined with .1019 gr. K

therefore

35.46 gr. Cl were combined with 40.67 gr. K.

The End Fractions.

The mother liquors obtained from the precipitation of KCl from aqueous solution by HCl gas were collected and concentrated until crystallisation occurred. The mother liquor drained off from these crystals (crystals were almost pure KCl) was reheated and again crystallised and this was repeated three times and the final mother liquor was diluted and then evaporated, leaving a brown residue which contained

Fe trace, Al, Mg, Ca trace, Phosphate, Sulphate, no Bromide or Iodide.

When made alkaline methylamine, CH_3NH_2, was evolved on heating. It was identified as its platinichloride which left 41.3 per cent. Pt on ignition. The main constituent, however, was KCl.

The least soluble fractions and the discarded first crops of crystals were also examined and found to be well over 90 per cent. KCl. Some K_2SO_4 was also present,

as well as $CaSO_4$, traces of Na, but Cs. Rb, Li and other elements were not detected in these fractions.

Analyses of Chloride from Old Metallic Potassium.

It was pointed out in *The Chemical News*, 1926, cxxxii, 193, and in *School Science Review* (1926, p. 261), that potassium metal sometimes behaved in an anomalous manner and instances of its explosive character have been frequent, especially in the case of very old specimens. This has been attributed to the formation of potassium carbonyl, $K_6(CO)_6$ and it was thought of interest to examine some old potassium which had remained at least twenty years in the laboratory stock and since it was in the form of round balls, had presumably been made by the old process of distilling potassium carbonate with carbon.

About 6 gr. of this potassium was cut into small pieces and thrown on to water (100 c.c.) contained in a shallow dish. The resulting KOH was neutralised with concentrated HCl and crystallised. The crystals were dissolved in a minimum of water which was then saturated with HCl gas in the usual way. The KCl so precipitated was re-crystallised from hot water and the crystals so obtained amounted to 0.4 gr. and were probably not so pure as those obtained from the potato ashes, although from spectroscopic examination the only observed impurity was sodium.

On analysis

.2775 gr. gave .5311 gr. AgCl, equivalent to .1332 gr. Cl.

therefore

.1332 gr. Cl are combined with .1423 gr. K

and

35.46 gr. Cl are combined with 39.04 gr. K.

The radioactivity of this specimen of KCl, as indicated by its action on a photographic plate was about the same as that of ordinary KCl.

Whilst this investigation was in progress H. H. Lowry (*J. Am. Chem. Soc.*, 1930, lii, 4332) has made a determination of the atomic weight of potassium from plant ash. He obtained about 20 gr. of sodium-free KCl from 25 lbs. of cotton seed hairs and from 75 lbs. of 4X superfine flour—wheat kernels. The amount of ash obtained is not stated but the potassium was found to have an atomic weight of $39.111 \pm .013$ and $39.091 \pm .016$, *i.e.*, there was no enrichment of the higher isotope in the material examined.

V. Vernadsky (*Comptes Rendus* (Paris), 1930, cxci, 421) and *C. R.* (Leningrad) 1930, No. 15, p. 399) has studied the radio activity of aquatic plants and petroliferous waters and has concluded that plants can accumulate radium compounds in their tissue and he even states that the concentration of radium in natural waters must be connected with some biological process on the earth's surface.

In a study of the radioactivity of the alkali metals Muhlhoff (*Annalen der Physik*, 1930, vii, 207) states that the half life period of potassium is 1.5×10^{13} years, or assuming that only the higher isotope is radioactive this would be 7.5×10^{11} years for the 5 per cent of the isotope, 41, in ordinary potassium salts.

CORRESPONDENCE.

ISOTOPES AND LIVING MATTER.

(*To the Editor of* The Chemical News.)

Sir,—I have read with the greatest interest the paper of Loring and Druce (*Chem. News*, 1930, cxl, 34) on the atomic weight of potassium in relation to living organisms.

I would direct their attention to my paper, in Russian, on "Isotopes and Living Matter," which was published in the *Bulletin de l'Academie des Sciences de l'U.S.S.R* (Section A.L. 1926, pp. 215-218), in which I try to establish the hypothesis of the existence of the biological separation of the isotopes from the isotopic mixtures (which correspond to many of the chemical elements, necessary for the life) as a general function of the living organisms (living matter).

To try this hypothesis I conducted during these last three years (in the very difficult conditions of my laboratories — State Radium Institute and Biochemical Laboratory of the Academy of Science of the Union) *the separation of some chemical* elements from organisms and the determination of their atomic weights, which has not hitherto been made till now for substances of such origin.

I am now in possession of specimens of iron, magnesium, calcium, potassium, sulphur, silicon and zinc of such origin and we have begun the determination of their atomic weights.

Prof. V. Chlopin, of the Radium Institute, is occupied with the determination of

potassium extracted by Mrs. M. A. Pasvig Chlopina from the pea and bean seeds. I hope that these determinations will clear the disagreement about the atomic weights of potassium given by Loring and Druce and those given by H. H. Lowry (*J. Amer. Chemical Soc.*, 1930, LII, 4334).

DR. W. VERNADSKY.

Biogeochemical Laboratory of
Academy of Science,
Leningrad.
Ul. Roentgena. 1.

20 December, 1930.

SEVENTY YEARS AGO.
(From the Chemical News, Feb. 18, 1860)

New Method of detecting Nitric Acid in the Dry Way.

Professor W. Stein gives a method for detecting nitric acid in the dry way when combined with bases. When heated the nitrates of potash and soda give off oxygen, and form fixed nitrates. The nitrates of baryta, strontia, and lime together with those of magnesia, alumina, and the heavy metals, when heated give up the nitric acid, which is split into oxygen and nitrous acid. As however we do not always know with what base the acid may be combined, the author recommends the following mode of testing. He heats the substance in a test tube either with bisulphate of potash or oxide of lead, placing in the upper end of the tube a strip of filtering paper moistened with a slightly acid solntion of pure sulphate of iron. If the nitrates are present only in so small a quantity that the nitrous vapour is not itself perceptible, the paper becomes of a yellowish brown colour. In this way the author discovered the 2000th part of nitric acid in a mixture, which by the usual moist way would have been impossible. The process is particularly applicable for the detection of nitric acid in spring waters. In applying the test it is necessary to guard against heating the paper. In the presence of chlorides the employment of bisulphate of potash is objectionable, because the liberated chlorine colours the paper by forming chloride of iron. The presence of protoxide of iron or much organic matter in the substance also interferes with the bisulphate of potash test.

A POSSIBLE TRANSITION FROM INORGANIC TO ORGANISED MATTER.

By MAURICE COPISAROW.

During the last century concentrated efforts were made, in many instances with signal success, to indicate some points of contact or borderline between biology and physico-chemical sciences. The study of organic metabolism as a series of physical and chemical changes and the synthesis of many of the products of organised life all lead to a more intimate connection between these branches of our knowledge.

However, our conception as to the relationship of cause and effect and such generality as the continuity of energy and matter would make us inclined to seek not lines of demarcation, but rather points of transition.

The tendency to place the essence of life beyond the scope of chemistry and physics, whilst admitting their usefulness in defining the details of all biological processes and functions, would seem to be due to (*a*) the incompleteness of our knowledge and (*b*) to the generally adopted analytical method of investigation.

The isolation and identification of materials associated with organised life, the expression of their behaviour or properties in terms of liquid crystals or colloids certainly may contribute to the attacks on the Vitalist theory and the elucidation of the details, but do not in any way solve the problem as to the essence of life. On the contrary, adopting a method of study in the order of possible genetic sequence, *i.e.*, synthetic in character, we may hope, our researches to be able to indicate ultimately the transition-stages between inorganic and organised matter.

Broadly speaking, we may characterise the metabolism of organised matter as the reversible transition of electrolytes into transitory and permanent colloids.* All vital functions are determined by the equilibrium of these phases and the permanent outline and structure of all organisms are produced by the physico-chemical complexes deposited by the interaction of these

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* The differentiation of colloids into transitory and permanent is of course but arbitrary and is introduced in the relative sense to denote considerable difference in stability.

forms, under conditions specific to each particular case.

I should like to refer here to the behaviour of some forms of matter, which though specifically inanimate in character, exhibit features usually associated with organised matter.

Glauber's Arbor Martis, a century-old *curiosity*, has of recent years shown signs of being not quite fruitless. We are able to produce now tree-like formations of a purely mineral character—the general appearance of which is defined by the tree substance and experimental conditions. Varying these we can at will obtain bamboo-, tree-, creeper-, or bushlike forms. These mineral growths are subject to the direct influence of light, the effect being very akin to that of the light-tropism of plants (Copisarow, *J.*, 1927, p. 233).

In these formations osmosis is the moving factor. Trees are however produced only when a transitory colloid is formed *in situ;* the actual tree substance is made up of a physico-chemical complex, a product of reaction between the colloid and some constituent of the medium.

These trees were found to be hollow, the saline nutrient being drawn up the stem to react at points of least resistance, thus throwing out roots and branches—the tree walls playing the part of a semi-permeable membrane.

From the fact that the mineral arboreal growth is practically confined to a special colloidal condition—it follows, that we may expect only a limited number of substances to be capable of yielding such forms. A systematic survey showed that the mineral tree growth is, with the exception of a few dwarf formations, practically restricted to the silicates and alkaline earth salts. Thus we find that the siliceous and calcareous structures of organised matter, such as shells and skeletons, find their counterpart in the range of mineral trees. This striking agreement can hardly be accidental, it is no doubt due to the identity of the underlying causes in both instances, and dealing with these mineral trees we are probably dealing with the very inception of organised matter.

The following description of the stages of development of calcium carbonate trees (Copisarow, *J.* 1927, p. 230: *Koll. Zeits.*, 1929, *47*, p. 60) will serve to illustrate not only the complexity of the process, but is also bound to force upon us the significance of the analogy between these forms and organised matter.

On carefully running 600 c.c. of a 7 per cent. solution of pure sodium carbonate on to 200 c.c. of a 38 per cent. solution of pure calcium chloride contained in a 1000 c.c. glass cylinder, both solutions being at room temperature, a gelatinous semi-permeable membrane of hydrocalcite was formed. After 2 hours, the membrane had increased in thickness, the bottom part of the calcium carbonate (the original membrane) showing distinct signs of changing from the translucent gelatinous condition to an opaque white crystalline solid. After 4-5 hours, the membrane had increased in opacity and thickness, showing the solid to be uniformly distributed in asbestos-like layers, which in the course of 2 or 3 days spread to a depth of 1.2 cm. Simultaneously with the hardening of the membrane, one or more protuberances or hillocks were observed on the upper layer of the solid. The hillocks soon resembled miniature volcanoes, the erruptions taking the form or fine streamers extending nearly to the surface of the liquid in straight, though not always vertical, chains of gelatinous particles of calcium carbonate. The shot-out streamers, on reaching the surface of the liquid, appeared to bend over and then gradually vanish, giving rise to the remarkable phenomenon of opacity bands or rings, distributed uniformly throughout the upper part of the sodium carbonate solution. In place of the streamers trees began to grow, taking their origin from the protuberances. The trees had the appearance of a wavy, white line or column in a spiral form, the corrugated surface of the column recalling stalagmites or icicles. Not infrequently, the trees were imperfect in their spiral form, being confined almost to one plane. In these cases the wave maxima invariably coincided with the opacity bands.

After 12-20 hours, the trees extended to the surface of the liquid, often creeping along the walls of the vessel. On nearly reaching the surface, the trees spread into a growth resembling sea plants. This foliage, or calcium carbonte in layers, gradually fell on to the membrane, carrying with it some of the trees, and completely destroying the opacity regions already disturbed by the growth of trees. The phenomenon of layers and tree formation persisted apparently indefinitely, provided that experimental conditions remained constant.

Repeated destruction of the calcium carbonate tree growth resulted in a new vegetation upon the debris, provided the two starting salt solutions were not exhausted. The trees in a each subsequent growth were thicker and fewer in number than their predecessors, this being apparently due to the altered osmotic pressure and increased obstruction to diffusion. The direction of the trees was found to be influenced not only by light but also by mechanical means. On inserting carefully a wire or a stiff vegetable fibre close to the protuberances the trees could be trained to creep up it in any desired direction.

On dropping a piece of fused calcium chloride into a 4 per cent solution of sodium carbonate (contained in a tall beaker) the calcium chloride gradually melted and became surrounded by a translucent jelly-like lake. In a very short time the jagged edges of the lake began to extend along the bottom of the beaker, assuming a star-fish like effect retaining the remains of the original solid in its centre. This was followed by the surface of the lake becoming opaque and rugged, streamers being shot out at various points, but mainly at the promontories of the arm extensions, the streamers being succeeded by small protuberances or hillocks, from which rose small thin trees seldom reaching the surface. Not infrequently these trees sent out numerous branches resembling a bush growth, the star-like extensions serving as a common root and substratum for the vegetation.

The formation of protuberances and eruption or effusion of myriads of colloidal particles referred to above seems to be characteristic to osmosis of mineral matter, in which arboreal growth is produced.

The physico-chemical complexes—the substance of the mineral trees—are cell-like in structure, being derived from a colloidal magma.

Similar to crystalloids — colloids yield characteristic configurations on ageing or dehydration, the pectographs being the outcome of the transfer of the intramicellar water to the inter-micellar areas. (Bary. *Rev. gen. Coll.* 1928, 6, 209; Bary and Rubio, *ibid.* 1929, 7, 308, Keenan, *Koll. Zeit.*, 1929, 47, 289; Schultze *ibid*, 1930, 50, 106; *ibid*, 1930, 51, 289.)

The direction of the growth of these artificial treeforms is determined by optimum conditions, such as least resistance, influence of light, reacting constituents of the medium, etc.

Growth inhibited by the gradually diminishing permeability of the old sections of the treewalls is naturally intensified in the new portions, thus enforcing a continuous development of new surfaces. This tendency becomes a general principle of growth, the actual configurations of the forms varying widely with the constituents and environment. In such a manner we obtain mineral trees of spiral, corrugated, granular, foliated and other types. But how can we visualise the passage of this mere outline or shadow to a being in all its complexity? Assuming this we may ask a more direct question, what part do mineral trees play in such a scheme of genetic sequence?

It would seem to me, that mineral trees, although certainly the most primitive life-like formations, were in themselves only secondary contributors to the origin of organic and organised matter.

All available evidence appears to converge in indicating the arboreal effusions, already referred to under opacity synthesis. This colloidal emanation, probably in marine surroundings, became the centre of chemical activity. Photosynthesis was followed by oxidation, reduction, condensation and polymerisation.

The organic matter so produced remained in the main combined with the mineral substratum, forming in course of time units of growing complexity. Simultaneously with this the character of the medium itself underwent a gradual but radical transformation the saline components being reacted upon by a portion of the organic matter.

With the augmentation of the organic constituents of the units—a sectional differentiation set in—each section assuming specific composition and functions.

The gradual development of enzymatic excretions gave a great impetus to all functions, whilst the emergence of organic and metallo-organic permanent colloids becoming a self-contained unit or complex cell, capable of combining all activities of the parent organism.

In such surroundings the mineral trees became altered not only in their composition, but in a still more remarkable way in all their functions. As to cell formation, it was probably realised not only by osmosis and the ageing of the colloid, but also by the powerful action of various products of the cell-metabolism inducing the fission of the cell. So for example Formaldehyde, probably the first stage in the photochemi-

cal synthesis of carbohydrates, may perhaps serve such purpose, as its action on protein matter results in distinct cellular formations (Copisarow, *Koll. Zeits.* 1929, 49, p. 309).

The qualitative and quantitative invariability and predominance of the mineral components both in and around the cell nucleus even in the present day highly developed organisms (Copisarow, *Chemical News*, 1927, pp. 305, 323, 338) forces upon us the evolutionary significance of these facts, and induces us to trace the cell back to its simpler ancestral mineral form.

Our experience with the primitive mineral trees and all their subsidiaries would tend to make us seek a concrete genetic relationship between both marine and land vegetation and such organisms as viruses, plankton and bacteria. Perhaps such minute organisms in some embryonic form are being thrown out all the time by our plants, in a manner similar to the expulsion of colloidal particles by mineral trees. Under such circumstances the higher organisms would become, at least at some period of their existence, not only the hosts or breeding fields for the lower types, but actually the generating stations for the more primitive organisms. Such supposition is not utterly impossible, being supported by such facts as the mitogenetic influence exerted by various cell emanations. So Gurwitsch (*Compt. rend.*, 1927, 184, pp. 841, 903) observed such influence to be exerted by embryonic tissues on the roots of the onion and on yeast cells.

Similarly, Magrou and Choucron (*Compt. rend.*, 1929, 188, p. 733 found the developing eggs of Echinus miliaris to be affected by the effusion from Bacterium tumefaciens, an influence which Choucron (*Journ. Mar. Biol. Ass.*, 1930, 17, p. 65) proved to be of a material character.

This effusion by dividing or mature cells would appear to be not only material but of a complexity much beyond that of an ordinary volatile organic irritant.

We have a continually increasing accumulation of facts indicating that not only enzymes, but such enigmatic forms as ultraviruses and viruses are the offsprings of bacteria. Here of course we are treading very much on unknown ground, and the status of the invisible viruses is still a matter of contention, some investigators being inclined to regard them as a separate impalpable species, bridging colloids with bacteria (Schuurmann, *Koll. Zeit*, 1930, 53, p. 231.)

FAILURE OF THE FERTILIZER INDUSTRY TO MEET SOVIET AGRICULTURAL DEMANDS.

At the conference of the All-Union Mineral Fertilizer Industry, held in Moscow recently, and reported in "Za Industrializatiyu," it was admitted that, despite the fact that the producing capacity of the Soviet Union increased considerably (93 per cent.) during the second of the Five-Year Plan, the fertilizer industry has not carried out the work laid down for it under the Five-Year Plan. The Plan for 1929-30 estimated for covering one-third of the required quantity of superphosphates and one-fifth phosphorite flour. In 1929-30 the fertilizer industry fulfilled the 1929-30 plans to the extent of 83 per cent. of superphosphates, 53 per cent. of phosphorite flour, 60 per cent. of phosphorites for grinding and 45 per cent. of phosphorites for soluble phosphates. Last year the fertilizer industry covered the needs of agriculture as follows :—20 per cent. of the total required quantity of phosphorite flour and 25 per cent. of superphosphates. The producing capacity of the fertilized industry as it is at present does not satisfy the demands of Russian agriculture and fertilizers will have to be purchased abroad.

In connection with the constructive plans laid down for the Soviet fertilizer industry, it should be of interest to manufacturers to note that it is proposed to mechanise the phosphorite mines, replacing shovel and pick by excavators. — *British-Russian Gazette.*

MARKET FOR DISINFECTANTS INSECTICIDES AND ANIMAL DRESSINGS IN PORTUGAL.

A confidential report on the market for disinfectants insecticides and animal dressings in Portugal has been prepared by the Department of Overseas Trade from information furnished by the Commercial Secretary to His Majesty's Embassy at Lisbon and furnished to firms whose names are entered on its Special Register.

United Kingdom firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference B.X. 6935 should be quoted).

THE COLLINSICS OF MINERALS. XVI.

By HAWKSWORTH COLLINS, B.A. (Camb.)

Thirteen collinsics are given in Table XXXIV. The first is one of the fifty which were omitted for reasons given in the last paper. The other twelve each contain manganese, which is the only new element introduced.

The first seven of these show Mn to have the volume 13.02 and O.R. 11.53. The next three show that Mn may have the R.V. 11.53 with a corresponding O.R. 13.02, just the other way round. And the last two are examples of the two forms occurring in the same mineral.

The first line of each collinsic gives the name and formula of the mineral. The second line gives the specific gravity, theoretical and observed. The third gives the formula arranged as required. The fourth gives (between the brackets) the relative volume of each atom, together with the product obtained by multiplying the total volume by $\mu - 1$, where μ is the normal refractive index of the mineral. The fifth gives the theoretical and observed refractive indices. The sixth gives the optical refractivity of each element and also their sum, which in all the 197 collinsics corresponds to four figures at least with the product of the fourth line directly above it. The O.R. of each atom is placed directly under its R.V. The thick type gives the discovery, whilst the ordinary type gives the experimental data.

TABLE XXXIV.

THE COLLINSICS OF THIRTEEN MINERALS.

(185) Francolite $Ca_{10}F_2CO_3P_6O_{24}.H_2O$

Theor. S.G. **3.10** Obs. S.G. 3.1 W

Ca_{10} + F_2 + C + P_6 + O + O_6 + O_{20} + H_2O

217.737 = 0.622(14.54_{10} + 5.42_2 + 8 + 14.56_6 + 7.53 + 4.45_6 + 2.51_{20} + 14.03)

Theor. R.I. **1.622** Obs. R.I. N_0 1.625 W 1.614 - 1.627 W

217.741 = 10.52_{10} + 0.26_2 + 3.333 + 10.51_6 + 1.654 + 1.747_6 + 1.346_{20} + 6.572

(186) Tephroite Mn_2SiO_4

Theor S.G. **4.114** Obs. S.G. 4.10 D 4.12 D

Mn_2 + Si + O_4

39.972 = 0.8141(13.02_2 + 13.02 + 2.51_4)

Theor. R.I. **1.8141** Obs. R.I. 1.8 M

39.974 = 11.53_2 + 11.53 + 1.346_4

(187) Glaucochroite $CaMnSiO_4$

Theor. S.G. **3.431** Obs. S.G. 3.41 W

Ca + Mn + Si + O_2 + O_2

39.763 = 0.7296(14.54 + 13.02 + 13.02 + 4.45_2 + 2.51_2)

Theor. R.I. **1.7296** Obs. R.I. 1.722 W

39.766 = 10.52 + 11.53 + 11.53 + 1.747_2 + 1.346_2

(188) Leucophenicite $Mn_5(MnOH)_2(SiO_4)_3$

Theor. S.G. **3.8453** Obs. S.G. 3.85 W

Mn_7 + H_2 + Si_3 + O_2 + O_{12}

140.146 = 0.7754(13.02_7 + 5.76_2 + 13.02_3 + 4.45_2 + 2.51_{12})

Theor. R.I. **1.7754** Obs. R.I. N_m 1.771 - 1.778 W

140.172 = 11.53_7 + 2.613_2 + 11.53_3 + 1.747_2 + 1.346_{12}

(189) Rhodonite $MnSiO_3$

Theor. S.G. **3.607** Obs. S.G. 3.63 Herm

Mn + Si + O + O_2

25.7436 = 0.7088(13.02 + 13.83 + 4.45 + 2.51_2)

Theor. R.I. **1.7088** Obs. R.I. 1.72 M

25.749 = 11.53 + 9.78 + 1.747 + 1.346_2

(190) Sarkinite $Mn_2(OH)AsO_4$
Theor. S.G. **4.161** Obs. S.G. 4.145 D 4.17 D
Mn_2 + H + As + O_5
50.153 = 0.7845(13.02_2 + 5.76 + 19.58 + 2.51_5)
Theor. R.I. **1.7845** Obs. R.I. N_m 1.793 W N_p 1.780 W
50.153 = 11.53_2 + 2.613 + 17.75 + 1.346_5

(191) Hureaulite $H_2Mn_5P_4O_{16}.4H_2O$
Theor. S.G. **3.154** Obs. S.G. 3.18 W
H_2 + Mn_5 + P_4 + O_{16} + 4aq.
152.737 = 0.6608(5.76_2 + 13.02_5 + 14.56_4 + 2.51_{16} + 14.03_4)
Theor. R.I. **1.6608** Obs. R.I. N_g 1.660 W N_m 1.654 W
152.740 = 2.613_2 + 11.53_5 + 10.51_4 + 1.346_{16} + 6.572_4

(192) Trimerite $Be_3Mn_2Ca(SiO_4)_3$
Theor. S.G. **3.47** Obs. S.G. 3.47 W
Be_3 + Mn_2 + Ca + Si_3 + O_3 + O_9
94.2004 = 0.7214(4.62_3 + 13.02_2 + 13.25 + 13.83_3 + 4.45_3 + 2.51_9)
Theor. R.I. **1.7214** Obs. R.I. N_m 1.7202 W N_g 1.7253 W
94.204 = 3.733_3 + 11.53_2 + 13.25 + 9.78_3 + 1.747_3 + 1.346_9

(193) Kempite $MnCl_2.3MnO_2.3H_2O$
Theor. S.G. **2.954** Obs. S.G. 2.94 W
Mn_4 + Cl_2 + O_2 + O_3 + O + 3aq.
103.3156 = 0.692(11.53_4 + 15.085_2 + 7.53_2 + 4.45_3 + 2.51 + 14.03_3)
Theor. R.I. **1.692** Obs. R.I. N_m 1.695 W N_p 1.684 W
103.331 = 13.02_4 + 10.82_2 + 1.654_2 + 1.747_3 + 1.346 + 6.572_3

(194) Manganspinel $MnAl_2O_4$
Theor. S.G. **4.0** Obs. S.G. 4.05 W
Mn + Al_2 + O_2 + O_2
34.936 = 0.8022(11.53 + 9.05_2 + 4.45_2 + 2.51_2)
Theor. R.I. **1.8022** Obs. R.I. 1.8 ± W
34.936 = 13.02 + 7.865_2 + 1.747_2 + 1.346_2

(195) Flinkite $Mn_3(OH)_4AsO_4$
Theor. S.G. **3.824** Obs. S.G. 3.87 D
Mn_3 + H_4 + As + O_8
78.036 = 0.8021(11.53_3 + 5.76_4 + 19.58 + 2.51_8)
Theor. R.I. **1.8021** Obs. R.I. N_m 1.801 W
78.030 = 13.02_3 + 2.613_4 + 17.75 + 1.346_8

(196) Stewartite $Mn_3P_2O_8.4H_2O$
Theor. S.G. **2.94** Obs. S.G. 2.94 W
Mn_2 + Mn + P_2 + O_2 + O_6 + 4aq.
96.444 = 0.66385(11.53_2 + 13.02 + 14.56_2 + 4.45_2 + 2.51_6 + 14.03_4)
Theor. R.I. **1.66385** Obs. R.I. N_m 1.66 W N_g 1.69 W
96.448 = 13.02_2 + 11.53 + 10.51_2 + 1.747_2 + 1.346_6 + 6.572_4

(197) Allactite $4Mn(OH)_2.Mn_3As_2O_8$
Theor. S.G. **3.8** Obs. S.G. 3.83 D
Mn_4 + Mn_3 + As_2 + H_8 + O_{16}
164.61 = 0.7817(11.53_4 + 13.02_3 + 19.58_2 + 5.76_8 + 2.51_{16})
Theor. R.I. **1.7817** Obs. R.I. N_m 1.786 W N_p 1.761 W
164.61 = 13.02_4 + 11.53_3 + 17.75_2 + 2.613_8 + 1.346_{16}

TABLE XXXV.

THE VOLOPTICS OF THE REQUIRED ELEMENTS (as found by the first 192 collinsics).

Element	Relative Volume	Optical Refractivity	No. of times this voloptic has occurred in the first 192 Collinsics
C	8	3.333	21
F	5.42	0.26	24
Be	4.62	3.733	20
H	5.76	2.618	851
Ca	14.54	10.52	90
Ca	13.25	13.25	26
Si	18.91	10.461	47
Si	17.61	9.625	59
Si	13.83	9.78	58
Si	13.02	11.53	71
O	7.53	1.654	261
O	4.45	1.747	243
O	2.51	1.346	1477
Mn	13.02	11.53	23
Mn	11.53	13.02	15
Na	11.865	3.865	60
Al	9.05	7.865	109
Al	12.05	4.863	32
P	14.56	10.51	63
As	19.58	17.75	40
Cl	15.085	10.82	32

METHOD OF DISCOVERY OF THE COLLINSIC OF FRANCOLITE.

If the molecular weight 1086 be divided by 3.1 the result is about 350. When 350 is multiplied by 0.62 the product is 217. It is therefore settled by the data provided that the total relative volume of the molecule must be about 350 and that the total optical refractivities of the elements must be about 217.

Since the O.R.'s of the three forms of oxygen do not differ greatly, and since one of them (1.346) is far more common than the others, the first approximation to the truth will start by supposing each of the 27 oxygen atoms to have the volume 2 .51 and O.R. 1.346

R.V.	O.R.
2.51	1.346
27	27
17 57	9 422
50 2	26 92
67.77	36.342

From Table XXXV take the R.V.'s and O.R.'s of F, C, P and H_2O, and add :—

R.V.	O.R.
67.77	36.342
10.84 = 2 × 5.42	.52 = 2 × 0.26
8	3.333
87.36 = 6 × 14.56	63.06 = 6 × 10.51
14.03	6.572
188.00	109.827

Subtracting 109.827 from 217, 107.173 is obtained. Dividing this by ten the result is 10.7173. This ought to be rather greater than one of the given O.R.'s of Ca because there may be some of the other atoms of oxygen present. From Table XXXV 10.52 is the O.R. required and its corresponding R.V. 14.54. Add these to the preceding results.

R.V.	O.R.
188.00	109.827
145.4 = 10 × 14.54	105.2 = 10 × 10.52
333.4	215.027

Subtracting 333.4 from 350, and 215.027 from 217, the results are about 16.6 and 2. If these differences cannot be accounted for by the higher oxygen atoms, the problem cannot be solved. The most usual state of affairs for the group PO_4 is that one oxygen atom has the R.V. 4.45 and the other three each 2.51; and for the group CO_3 the most common is one 7.53 and two 2.51. Adding the 6 differences of oxygen for P and the one for C to each side, the results are the same as given in No. 185.

R.V.

333.4
11.64 = 6(4.45 - 2.51)
5.02 = 7.53 - 2.51

350.06

O.R.

215.027
2.406 = 6(1.747 - 1.346)
.308 = 1.654 - 1.346

217.741

It will be noticed that in this case both the theor. S.G. and the theor. R.I. are in exact accordanee with the observed values. There is no hypothesis, no ambiguity and no jugglery anywhere in the collinsic, and there is no other solution of the problem.

THE STRUCTURE OF MANGANESE.

In three of these collinsics, Nos. 186-188, Mn and Si both have volumes 13.02 and at the same time they each have O.R. 11.53. In the *Chemical News* (1925, cxxxi, 355) Mn was shown to have the two volumes 13.02

and 11.53 and in the *Chemical News* (1924, cxxix, 47), Si was shown to have the same two volumes. These facts in conjunction with the remarks made above in the second paragraph may appear rather bewildering; so itseems advisahle to put them in tabular form :—

TABLE XXXVI.

	R.V.	O.R.
Mn	13.02	11.53
Mn	11.53	13.02
Si	13.02	11.53
Si	11.53	not known

In all these cases the optical refractivity is equal to a relative volume of the same element. Many similar results have already been demonstrated, and there are several to come; so that the law of optical refractivity when it can be formulated and the reason for it discovered, is certain to throw a very strong light upon the constitution and structure of the elements.

The law of relative volume (*Chemical News*, 1926, cxxxii, 325), is involved in the problem of the structure of an atom of Mn, which is now more certain than ever to have been formed by the union of one atom of Si with one of Al. This matter cannot be properly appreciated without reference to the three papers mentioned above.

ELIMINATION OF EXPERIMENTAL ERRORS.

It is evident that experimental errors are eliminated by the collinsics, because each voloptic is common to several minerals, and therefore it cannot possibly take any account of impurities in any one of these minerals.

VISIT OF COMMERCIAL SECRETARY TO EMBASSY AT RIO DE JANEIRO.

The Department of Overseas Trade announce that Mr. Stanley G. Irving, the Commercial Secretary to His Majesty's Embassy at Rio de Janeiro, is now in this country on an official visit.

Mr. Irving will be available at the offices of the Department during the periods 2nd-6th and 23rd-27th February, to interview manufacturers and merchants interested in the export of British goods to Brazil. He will also visit a number of indnstrial centres in the Provinces.

Firms desiring interviews with Mr. Irving in London, or information regarding his arrangements to visit provincial centres should apply to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street. London, S.W.1, quoting the reference 2111/1/30.

SIR A. EDDINGTON ON "THE END OF THE WORLD."

At the Annual Meeting of the Mathematical Association at the London Day Training College on January 5, the President, Sir A. Eddington, spoke on "The End of the World" from the mathematical standpoint. He said the world—or space-time—was a four-dimensional continuum, and offered a choice of many directions in which they might start off to look for an end. They no longer looked for an end to the world in its space dimensions. There was every reason to believe that so far as its space dimensions were concerned the world was of spherical type. This spherical space was expanding rather rapidly; in fact, if they wished to travel round the world and get back to their starting point they would have to move faster than light. While they were loitering on the way the track ahead of them was lengthening. It was like trying to run a race in which the finishing-tape was moving ahead faster than the runners. The radius of space to-day was not known, but he should estimate that it was not less than 10 times the original radius..

The world was open in both directions in its time dimension. There was no bending ronnd in time to bring them back to the moment from which they started. If they were looking for an end of the world or, instead of an end, an indefinite continuation for ever and ever, they must start off in one of the two time directions. How should they decide which of these two directions to take? There ought to be a sign-post with one arm marked "To the Future" and the other arm marked "To the Past." If he made a mistake and went the wrong way he would lead them to what was no doubt an "end of the world," but it was that end which was more usually described as the beginning.

Leaving aside the guidance of consciousness, it had been found possible to discover a kind of sign-post for time in the physical world. The distinction was provided by a certain measurable quantity called entropy. Entropy was a very peculiar conception, and might he most conveniently described as the measure of disorganisation of a system. Accordingly the sign-post for time resolved itself into the law that disorganisation increased from past to future. There was no other indenendent sign-post for time. Evolution taught that more and more highly organised systems developed as time went on, but this did not contradict the conclu-

sion that on the whole there was a loss of organisation. With ever-increasing disorganisation ahead, the phenomenon of evolution must be swallowed up in the advancing tide of chance and chaos, and the whole universe would reach a state of complete disorganisation—a uniform featureless mass in thermodynamic equilibrium. This was the end of the world. Time would extend on and on presumably to infinity, but there would be no definable sense in which it could be said to go on.

Following time backwards, if they were not stopped earlier they must come to a time when the matter and energy of the world had the maximum possible organisation. They came to an abrupt end of space-time, only it was generally called the beginning.

At the conclusion of his address, Sir Arthur Eddington said he supposed that to justify its title he ought to conclude with a prophecy of what the end of the world would be like. He was not very keen on the task. It used to be thought that in the end all the matter of the universe would collect into one rather dense ball at uniform temperature; but the doctrine of spherical space, and more especially recent results concerning the expansion of the universe, had changed that. There were one or two unsettled points which prevented a definite conclusion, so he would content himself with stating one of several possibilities. It was widely thought that matter slowly changed into radiation. If so, it would seem that the universe would ultimately become a ball of radiation, growing ever larger, the radiation becoming thinner and passing into longer and longer wave-lengths. About every 1,500,000,090 years it would double its radius, and its size would go on expanding in this way in geometrical progression for ever.

ACHEMA VII.

The Acheme VII, the exhibition of chemical apparatus which is to be instituted in 1933 by the DECHEMA, Deutsche Gesellschaft für chemisches Apparatewesen E.V. has already attracted notifications of their intention to take part from 134 firms, this in spite of the fact that the venue of the exhibition has not yet been determined. Of these firms 63 have already reserved stands so that about 2000 sq. metres of exhibition floor space have now been ordered in advance.

GENERAL NOTES

DISPLAY OF SCIENTIFIC APPARATUS.

There are many things to interest both the technical expert and the novice at the Twenty-first Annual Exhibition of the Physical and Optical Societies which was opened on January 5 by Professor Sir Arthur Eddington at the Imperial College of Science and Technology, South Kensington. In his opening address Professor Eddington said that the Exhibition showed the dependence upon each other of the instrument maker and the scientific worker. Scientists were very interested in seeing the results of the work of the instrument makers, who generally professed to be unscientific. They would say : " We don't really calculate out these curves and dimensions; we go on by trial and error until it comes right." This did not shock Professor Eddington, who was of the opinion that " trial and error " could be as scientific as any other method. The scientific worker helped the instrument maker by stimulating the satisfaction of new requirements .

Professor Eddington commented on the history of the telescope and the progress in the design of this instrument, due chiefly to the discovery of achromatic object glasses in 1733 and the development of reflecting telescopes. Great hopes for further developmeut were centred on the projected 200 inch reflector which the Carnegie Institution had decided upon. Similar important results might well be obtained by oue of those simple, almost accidental, discoveries in the laboratory. This progress, however, had made the scientific worker dependent on highly complex and expensive instruments, which, once acquired, had to be used to the utmost. The days were past when one could put together in the workshop some " tintacks and sealing-wax " and then set to work and discover something. The Exhibition showed the latest appliances with which the scientific workers could equip themselves for further advance to wrest the secrets from the electron, the atom and the stars.

Recent Physical Research.

Over eighty firms are exhibiting in the trade section, and in addition there is a very interesting section dealing with recent physical research. In this latter the National Physical Laboratory has fifteen exhibits, one being an apparatus for making visible the flow of air past model aeroplanes, etc.

The Gramophone Company, Ltd. (H.M.V.) Research Laboratories is giving a demonstration of projected television and is also exhibiting a talkie amplifier. The Wool Industries Research Association has an instrument for measuring the friction between two cloth surfaces, and the Gas Light and Coke Company shows an interesting exhibit dealing with the protection of pipes from corrosion. Among other well-known bodies are British Thomson-Houston Co., Ltd., General Electric Co., Ltd., Research Laboratories, Post Office Engineering Research Station, Research Institute of the Cancer Hospital, Rothamsted Experimental Station, Supra Electra Motors Research Laboratory.

SECTION FOR APPRENTICES AND LEARNERS.

A recent addition to the Exhibition is a section designed to eucourage craftsmanship in the scientific instrument trade. Mass production has invaded this, like many other trades, to the detriment of the old skill and craftsmanship of the individual. This section has been introduced to enable apprentices and learners under 21 years of age to exhibit in competition for prizes. There are over seventy entrants.

Much of the apparatus shown in countless forms is to be fully appreciated only by the expert, but there is plenty to fascinate the scientifically uninformed.

THE MINERAL INDUSTRY OF CANADA IN 1930.

According to the official estimate of the Dominion Bureau of Statistics new records were established this year both in output and value in the production of gold, petroleum and natural gas and more copper and zinc was produced during 1930 than in any previous year in the mining history of Canada. Owing to the reduction in metal prices and lower outputs of non-metallics and structural materials the total value of production in 1930 at 276,865,000 dollars show a decrease of eleven per cent. from the record output of 310,850,000 dollars in 1929.

The metals group totalled 143,124,000 dollars, which was seven per cent. under the 1929 total of 154,454,000 dollars.

Gold production totalled 2,089,800 ounces valued at 43,199,000 dollars as compared with 39,862,000 dollars in 1929.

Silver production amounted to 26,171,000 ounces valued at 10,057, 000 dollars compared with the 1929 output of 23,143,000 ounces worth 12,264,000 dollars.

Copper production from Ontario, British Columbia, Quebec, Manitoba and a small amount from Nova Scotia totalled 301,017,000 pounds valued at 38,687,000 dollars compared with 248,121,000 pounds worth 43,415,000 dollars in the previous year.

The output of nickel totalled 103,782,000 pounds with an estimated value of 2,449,000 dollars and with a volume six per cent. below that of 1929.

CANADIAN MINERAL INDUSTRY.

Lead production totalled 329,034,000 pounds worth 12,992,000 dollars, an increase in quantity over 1929 but a decrease in value of twenty-one per cent.

The zinc output at 259,700,000 pounds, exceeded 1929, the previous record year, by 31 per cent. but the low price of zinc made the total value only 9,893,000 dollars. The 1929 output totalled 197,267,000 pounds worth 10,626,000 dollars.

Fuels including coal, natural gas and crude petroleum totalled 68,696,000 dollars compared with 76,787,000 dollars in 1929.

Coal production amounted to 14,925,000 short tons valued at 53,000,000 dollars, a decrease of 15 per cent. in quantity and 16 per cent. in value as compared with 1929.

Natural gas at 29,566,000,000 cubic feet worth 10,561,000 dollars created a new record. The wells in Alberta produced 69 per cent of the total output.

There was also a record in the production of crude petroleum, which amounted to 1,500,000 barrels valued at 5,120,000 dollars compared with 1,117,000 barrels worth 3,731,000 dollars in 1929.

Other non-metallic minerals including asbestos, gypsum, salt, feldspar, quartz and mica totalled 15,382,000 dollars compared with 21,074,000 dollars in the previous year.

Asbestos production totalled 244,000 tons worth 8,600,000 dollars.

The gypsum output totalled 1,060,000 tons worth 2,875,000 dollars.

Structural materials production including brick, cement, lime, stone, sand and gravel totalled 49.663.000 dollars as compared with 58.534,000 dollars in 1929.

The cement production totalled

10,857,000 barrels compared with 12,284,000 barrels last year.

In value the output of the mineral industry stands third among the primary industries of Canada, being exceeded only by agriculture and forestry. Over 95,000 men are employed in mining with an annual pay roll of over 125,000,000 dollars.

SENSITISED PAPER AND LINEN—EGYPT.

The *Commercial Secretary* to the Residency, Egypt, reports that the Ministry of Finance is calling for tenders, to be presented in Egypt by the 1st February, 1931, for the supply of sensitized paper, etc. (ferro gallate paper and linen and ferro-prussiate paper and linen).

Firms desirous of offering material of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 6979 should be quoted.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

APPLICATIONS FOR LICENCES IN DECEMBER, 1930.

The following statement relating to applications received during the month was 592, of which 539 were from merchants or importers. To these should be added 16 cases outstanding on the 29 November, 1930, making a total for the month of 608. These were dealt with as follows:—

Granted—572 (of which 557 were dealt with within 7 days of receipt).

Referred to British makers of similar products—23 (of which 20 were dealt with within 7 days of receipt).

Outstanding on 31 December—13.

Of the total of 608 applications received, 577, or 95 per cent., were dealt with within 7 days of receipt.

BRITISH INDUSTRIES FAIRS.

LONDON AND BIRMINGHAM, FEB. 16-27TH.

Special advance overseas editions of the catalogue relating to the British Industries Fairs held simutaneously in London and Birmingham have now appeared and are being sent to overseas buyers and prospective visitors in all parts of the world.

Proceedings and Notices of Societies

GEOLOGICAL SOCIETY OF LONDON.

December 17.

Prof. E. J. Garwood, M.A., Sc.D., F.R.S., *President*, in the chair.

The following paper was read:—

The Mechanics of Mountains. By DR. HAROLD JEFFREYS, M.A., F.R.S.

The Earth's upper crust in the continents appears from seismology to consist of three layers, an upper one of granitic constitution, about 10 km. thick, an intermediate one about 20 km. thick, the properties of which fit tachylyte, and a lower one probably of dunite. extending half-way to the centre of the Earth. Above the granitic layer is the sedimentary layer, with an average thickness of probably about 2 km., but considerably thicker in special regions. The outflow or inflow involved in maintaining isostatic compensation is in the lower layer, but at a smaller depth than 50 km.

The mechanical properties of the outer crust indicate that the crustal shortening in a major epoch of mountain formation should be of the order of 40 km. The actual height and extent of the great ranges correspond to a shortening of about 60 km. This estimate is arrived at by considering what elevation would be produced if the light upper layers were compressed by a given fraction of their original length and enough outflow in the dense lower layer took place to restore isostay.

This estimate is much less than the horizontal movement observed in the field, and it is suggested that the only possible explanation is that the horizontal movement is a surface-phenomenon almost confined to the sedimentary layer, and caused by the crustal shortening, but not equivalent to it.

It appears that prolonged deposition of sediments leads to an obstruction of the normal outflow of heat from the Earth, and hence to an increase of temperature and a reduction of strength through a depth of the order of 100 km., thereby localising the yield when the stresses due to contraction of the interior become too great for the

strength of the outer crust to withstand. The immediate result of a local failure would be a local elevation so high that the heated sediments would proceed, as a secondary effect, to flow out horizontally under gravity and give a series of flat folds closely resembling the observed nappes. Explanations of ' back-folding ' and of the gneissic core of a great mountain-system appear to follow naturally.

Emphasis is laid on the importance of recognising *the intermediate* layer in discussions of the mechanics of geological processes. Isostatic readjustment can take place by horizontal outflow in this layer as in the lower layer, though much more slowly, and it seems that this process may play an important part in the formation of geosynclines and the levelling of old mountain-systems.

Wednesday, January 14.

Additional Fossils from the Cambrian Rocks of Comley (Shropshire). By Edgar Sterling Cobbold, D.Sc., F.G.S.

This paper is intended as a supplement to those that appeared in the Society's Quarterly *Journal* in 1910, 1911, 1913, and 1921.

It is rendered necessary by the collection during the past twenty years of a few forms new to the Comley area and other specimens which throw light on species already described.

Species referred with reserve to *Micmacca* Matthew in 1910 are now confidently placed under that genus, or under *Strenuella*, and the relationships between *Protolenus*, *Strenuella*, and *Micmacca* are noted. The very plentiful *Ptychoparia attleborensis* Shaler & Foerste is placed under Walcott's genus of the Eodiscidæ, *Pagetia*, on the strength of an enrolled specimen of the complete dorsal shield. Some six or eight specimens of *Weymouthia nobilis* Ford throw considerable light on this species. Evidence is put forward for the presence of *Paradoxides sjögreni*. A new genus is proposed for an undescribed Lower Cambrian trilobite, which seems intermediate between *Dorypyge* and *Centrapleura.*

Certain Hyolithidæ are noted or described for the first time; Cystids, a Polvzoan, and *a* coral are recorded from the Lower Cambrian.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.
John Street, Adelphi, London, W.C.2.

Monday, January 26 at 8 p.m.—(Cantor Lecture.) " Some Modern Developments in Microscopy." (Lecture I.) By L. C. Martin, D.Sc. A.R.C.S., D.I.C.

INSTITUTE OF RUBBER INDUSTRY.

Thursday, January 22 at 7 p.m. in The Manchester, Ltd., Royal Exchange. " The Comparison of English and American Technique over the Last Decade. By E. H. Wallace, F.I.R.I.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

Belfast and District Section.

Thursday, January 22 at 7.30 p.m. in the Physics Lecture Theatre of tht Royal Belfast Academical Institution.—" D.O.R.A's Grandmother." By Dr. J. Hawthorne.

UNIVERSITY OF LONDON.

University College.

Friday, January 16 at 5.0 p.m.—" Comparative Physiology." First of a course of ten public lectures by G. P. Wells. January 16, 23, 30, February 6, 13, 20, 27, March 6, 13, and 20.

Thursday January 22, at 5 p.m.—"Wein, Eine alte Kulturstatte." A public lecture in German, By Dr. August Closs.

THE ROYAL INSTITUTE OF PUBLIC HEALTH.

The Annual Congress of the Institute 1931.

The Next Annual Congress will be held in the City of Frankfurt, during Whitsuntide, 1931, on the invitation of the German Government, the Oberburgmeister of Frankfurt, and the University of that City, and under the Presidency of the Most Hon. The Marquess of Reading, G.C.B., G.C.S.I., G.C.I.E., G.C.V.O. Further particulars can be obtained at the Institute, 7 Russell Square, London, W.C.1.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

LYTEX.

518,220.—A preparation for bleaching straw and other braids, being a chemical substance used in manufacture.—Ernest Blundell Lye, trading as T. Lye and Sons, The Dye and Bleaching Works, New Bedford Road, Luton. December 31.

CORRIELINE.

517,828.—Chemical substances used for veterinary purposes. — Duncan Campbell, 62, High Strett, Lockerbie, Scotland. December 31.

517,521.—A label device illustrating two nude children sitting back to back and both holding bowls. Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—Verkaufs-Stelle des Internationalensusstoff-Syndikats Gesellschaft mit Beschrankter Haftung, Bergstrasse 28, Hamburg, 1, Germany. December 31. (Associated).

517,511.—A label device illustrating two nude children sitting back to back holdings bowls. Chemical substances used for agricultural, horti-sultural, veterinary and sanitary purposes.—Verkaufsstelle Des Internationalen Susstoff-Syndikats Gesellschaft 28, Hamburg, 1, Germany. December 31. (Associated).

BINDING CASES.

Handsome Red Cloth (stiff) Binding Cases. Gold-lettered, for Binding the *Chemical News*, can now be had from the Office, Merton House, Salisbury Square, London, E.C.4., price 3/-; post free, 3/8.

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or *How to Reason Correctly*. By J. E. Roscoe, M.A., Oxon.

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CONFESSIONS OF GREAT SOULS.

By the Rev. J. E. Roscoe, M.A.

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ELECTROLYTIC WATER AS ACID.

By R. SAXON, B.Sc., F.C.S.,
Mem. Soc. Chem. Ind.,
Mem. Amer. Chem. Soc.

In a previous article the getting of copper, etc., in the ionic state is shown using the U tube and a septum of white glue and white sand. The blue and violet forms show np beautifully and the latter is the final form, the blue resulting from translucent suspended colloid hydroxide. The violet gives absorption bands not at all simple nor consistent. The bright green hydrate is translucent and its presence interferes with the violet very heavily. The rate of bubbling also has a market effect on the violet, a low voltage (below 50 voltsı gives nothing but blue, and a high one (180 to 250 v.) melts the septum. In such cases the latter is pushed towards the cathode. Even in cases where there is no perceptible melting the septum moves in the direction of the cathode.

The electrodes may be of platinum and carbon, or both platinum. If the anode be of carbon there will be produced carbon monoxide at that end. Now to represent these reactions by ordinary chemical equations is not to represent truth, for the reactions are not chemical as we understand from mixtures, but begin with the reverse. Thus, if we mix sodium hydroxide and hydrochloric acid we get sodium chloride and water, thus, $NaOH + HCl = NaCl + HOH$. The current, however, will reverse this, for when we send a current through salt solution we get sodium hydroxide and hydrochloric acid. Therefore if we represent this reaction by reversing the equation we ignore the charges on the electrodes. If

THE CHEMICAL NEWS

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the current gives the anode a stronger positive charge than the sodium has for the chlorine then disruption takes place in the region of influence of the anode which pulls away the negative chlorine. If the sodium thus liberated has no more positive force than that in the next molecule it cannot obtain its chlorine, and if we are to believe that that sodium, which is liberated by the anode pulling away its chlorine, takes away its neighbour's chlorine, then it must be something which displaces ordinary sodium. Thus the element is probably momentarily changed, but stoppage of the current brings about ordinary chemical conditions, the waves of potential subside, and sodium chloride once more forms. There should be a chain of waves of electrical potential along every chain of molecules between the electrodes, like waves of light, the crests occurring immediately before rupture, and the troughs with formations of new "couples," or new molecules. As we cannot do justice to the many theories of electrolysis by ordinary chemical formula, we represent our reactions by using the signs used in arithmetic for division for the electrodes, always putting the) on the left as the +, and the (on the right representing the −, as thus they fit in with the usual way of writing salts.

It is a non-commital method we use. It merely says what probably takes place by virtue of charge on electrode and that on element. Thus the electrolysis of water is shown as—

(*a*) No current flowing,

)HOH++HOH(

(*b*) Current on,

H)HO+H(OH

(*c*) "Exchange partners",

H)HOH(OH

(*d*) OH cannot keep thus unless it has a positive atom to cling to so it gives up oxygen to become water. We have only dealt with two molecules iu the example; we have to imagine a chain of them and deal with the end ones touching the electrodes.

Thus if we take a solution of common salt we illustrate as follows—

(*a*) No current,

)HOH+NaCl . . . HOH+NaCl(

(*b*) Current on,

H)OHNa/ClH . . . OHNa(Cl

As the reaction is not chemical in the usual sense the sign + is out of place, and the / used instead. The reaction does not take place in such alternate order most likely, but exchanges go on on all sides. Near the electrodes, however, it is probably as shown, and for that reason we represent it thus, and boil the symbolism down to the smallest number of molecules necessary, thus, with current flowing—

H)OHNa/ClH/(OH.

This says that a solution of salt gives off hydrogen at the cathode and OH at the anode. At that moment sodium hydroxide and hydrochloric acid are formed. For all we know these may be prevented from reacting with one another so long as the current is on. Take away the current and of course chemical action in the ordinary sense takes place.

Electrolytic Water on Metal Anodes.
Copper.

When we use a copper anode in pure water with a current of 200 volts there is a rapid liberation of hydrogen from the cathode, but *no gas from the anode*. This forms an interesting method of the *Preparation of Hydrogen*. We cannot make hydrogen from copper and acid. Here we can with water only. We only need an electrode under a boiling tube with copper anode to collect the gas sufficiently rapidly for demonstration purposes in 20 minutes. There is no mess, the copper anode remains clean, and the cathode coated with a little copper. For that reason it is as well to use a copper cathode also.

White copper hydroxide is given off at first which turns through a light translucent blue to a beautifully clear bright green hydroxide. The white hydroxide would appear to be the mono salt produced in a pure environment with plenty of copper to go at. This becomes the di-salt as OH is offered it. The upper portion of liquid in the cell is after a time yellow brown, lower bluish, and lower still violet. This latter is not so pronounced as with the colloid septum method. There is a pale bluish colloid matrix permeating the whole. Finally copper can be seen on the cathode and floor round its base. The reaction is shown thus, current on,

(*a*) White hydroxide,

H)OHH/OHH/ . . /(OHCu

(*b*) Green hydroxide,

HH)OHH/OHH/ . . . /(OHOHCu

Thus if HOH is ordinary water, OHH is something that the charge causes to "rotate" to the HOH dispensation.

PSYCHOCHEMISTRY (CHEMICAL PSYCHOLOGY).

By H. H. Stephenson.

The term psychophysics was invented by G. T. Fechner (1801-1887) to denote the study of the relations between the mental and the physical worlds. The science is now usually known as Physiological Psychology, and a considerable literature of books, and of journals like *Biometrika*, has grown up about it.

The fundamental law of psychophysics is that sensation is not in arithmetical relation to stimulus. That is, if you hit a man, he feels a certain hurt; but if you hit him twice, or three times, as hard, he does not feel twice, or three times, the hurt; he may only feel 1.4 and 1.7 times the hurt. The curve is logarithmic. People differ in the exact factor to be applied, but not in the general principle. Fechner's law is that intensity of sensation (I) is proportional to the logarithm of the stimulus : $I = k \log S$.

Colloidal and physiological chemistry have advanced to the extent that we should now be able to envisage a Psychochemistry, or Chemical Psychology. Immediately we learn Fechner's law, we are as chemists on familiar ground. The progress of nearly all chemical reactions is logarithmic. Mellor and other authors supply numberless equations containing the logarithmic base *e*. What we have to do is to restate the case in terms of chemistry. A nerve impulse is a chain of colloidal reactions; on reaching the brain it starts another chain of colloidal reactions. We are not in the land of physics, where an electric current through a copper wire registers on a metal galvanometer, and double the current registers double on the galvanometer.

It is necessary first to distinguish between the three stages of the journey from the *stimulus to the sensation*, as the logarithmic law may work in any one of them singly, or in any pair of them, or in all three. The stages are : (1) the nerve-message, (2) the brain reception, (3) the consciousness sensation. There are seven cases : three singles, three pairs, and all. Thus the nerve alone may act logarithmically, while brain and consciousness register arithmetically; or brain as well as nerve may act logarithmically, though with a different factor; and so on, for the other five cases. Factors supply a number of sub-cases.

It is when we come to the consciousness that we meet with the real difficulty. Nerve and brain are colloid. Heredity is the tendency for a certain colloidal condition to recur. Mendel's dominants and recessives are favoured or unfavoured by the colloidal conditions. Mutation is a sudden change of *colloidal condition*. But how are we to define consciousness in terms of the physical world Personally, I am unable to understand a materialist. I can only explain mind by assuming that it exists independently of matter. But as chemists we might say that consciousness is present when the colloidal reactions in the brain meet with resistance, and that the intensity of consciousness is in accord with the resistance. This explains habit and instinct. In habit the resistance, and therefore the consciousness, is diminished; instinct is hereditary habit meeting with no resistance and therefore attended by *no* consciousness. An innate idea (*e.g.*, the principle that the whole is greater than the part) is an expression of the fact that mind can only link with matter when the chemical process is working in the right direction. Unconscious cerebration—the mind undergoing modifications, sometimes of great importance, without being conscious of the process until the results present themselves to the consciousness in new ideas — is in psychology what mutation is in physiology.

It is time that chemists played their part in psychology. They have the initial advantage of their own researches in chemotherapy.

BUILDING SOCIETIES' STATISTICS.

A Paper entitled "An Analysis of Building Societies' Statistics read by Mr. J. Brace at the meeting of the Royal Statistical Society, held at 5.15 p.m. on Tuesday, *January 20, at the Royal Society of Arts*, John Street, Adelphi, London, W.C.2.

The following is a synopsis of the Paper :

Progress in membership and assets of building societies. Mortgage business. Examples of advances and analysis of returns therefrom. Investment business and rates offered. Comparison between development of building societies and other thrift organisations. Ratios of reserves. Costs of administration. Estimate of an ideal size for a building society. Amalgamation.

DUST IN CHIMNEY GASES.

The Size of the Particles now Being Removed.

(By a Well Known Engineer).

A great technical advance is represented by the solution of the problem of dust removal from chimney gases by Davidson Co., Ltd., of Belfast, with their patent centrifugal and gravity dust collector. This has proved so successful that already over 75 power stations in Great Britain are now equipped, *while altogether there are running*, at home and abroad, more than 500 collectors on steam generation plant, both power station and industrial, as well as about 400 collectors for dust removal in general, quite apart from boiler plants.

As a result of this extensive experience, which represents the removal of about 150,000 tons of dust per annum from chimney gases alone, it has been proved conclusively that 70-90 per cent. of the total dust is separated, which means in practice that the nuisance is completely eliminated.

Also this work has demonstrated the *amazing amount of dust in chimney gases*, representing 0.5-5 per cent. of the total coal fired in the case of mechanical stoking and hand firing, and anything up to 15 per cent. with pulverised fuel firing, which sounds incredible. There are, for example, a number of power stations running in *Great Britain* separating 150-200 tons of dust weekly with these collectors, so that *in the field of the innocuous chimney top* we can now regard black smoke, grit, and dust as non-existent under proper scientific conditions.

One of the most striking features of these *detailed researches and subsequent* commercial development is the extraordinary fine particles of dust that can be separated in this way, the principle of the Davidson apparatus being a casing of veloute shape, into which all the chimney gases pass tangentially at high speed, so that the *dust is separated by centrifugal force* which gradually increases as the radius of the veloute decreases, while gravity also plays a part in the matter the dust-free gases being discharged from the top of the casing and the collected dust taken away from the top of the casing and the collected dust taken away from the bottom, which is hopper shaped to assist the action of gravity.

To take some specific examples as showing the fine state of division of the separated dust, at the Leicester Power Station collectors of this character operating on eight mechanical stoker fired boilers are separating dust to the extent of 2.6-3 per cent. on the total weight of the coal fired, of which 39 *per cent will pass through* a 325 mesh per lineal inch sieve, that is below the size of 43 microns.

Also the investigations carried out in the firms laboratories and experimental test station at Belfast from typical power station dust, using pulverised fuel firing, showed the *grading to* be as follows :—

Left on 1600 D.I.N.	Screen	(above 150	microns)	3.5%
,, ,, 3600 ,,	,,	100-150	,,	4.9%
,, ,, 6400 ,,	,,	75-100	,,	6.5%
,, ,, 10,000 ,,	,,	60- 75	,,	8.2%
Through 10,000 ,,	,,	below 60	,,	76.9%

It is interesting to note also that this extremely *fine separated dust is* made up chiefly of carbon particles, more or less crystallised ash, and objects resembling hollow glass spheres, which are extremely light and will float on water.

Further the small amount of dust that escapes from the collectors to the air is of such an extremely fine character that about 97 per cent is of a size less than 60 microns, and a considerable proportion below 10 *microns*, that is really constituting a "cloud" or "smoke," and is of course entirely harmless because material of this kind will remain floating in the atmosphere indefinitely, like *many other* products, until washed down by the next shower of rain. The efficiency of the separation is therefore of a remarkable character and superior to other much more costly and *complicated* methods that have been suggested, such as filtering through asbestos bags and the action of gravity only, by slowing down the gas current.

SEVENTY YEARS AGO.
From the Chemical News, Feb. 25, 1860.

Chemical Nomenclature.

In glancing over some of the recent numbers of the CHEMICAL NEWS, I observed a passage of yours in reply to a correspondent, *A. P. S.* in No. 6, p. 72, which I think requires further elucidation at your hands. You say that being "better acquainted with the recent literature of chemistry, he (*A. P. S.*) would find no difficulty in the terms nitrate of *potassium*, chlorate of *barium*, &c., to which he alludes." I can say that all the manuals that have come to my hands—Kane, Brande, Graham, Miller, Gregory, &c., give no explanations that would lead any student to infer that the names above referred to, indicated the compound, $KNO_6 = KO.NO^5$ or $BaClO_6 = BaO.ClO_5$. They do explain, and advocate the propriety of attributing to the hydrogen of such acids as hydrochloric, sulphuric, nitric, phosphoric, and other similarly constituted acids the power of acidification rather than to the other components; also the consistency of having not *two* classes of acids and *two* classes of salts—such for instance as the hydracid and oxacid salts—but one class of acids, and one of salts, the nomenclature of which should not exhibit such inconsistent diversity as the system of nomination aud representation of the preceding classes as hitherto practised manifest.

If in the new system of formulæ tabulation you assume for the positive element, hydrogen in the acid $HO.NO_5$ or HNO_6—nitric acid—the acidifying power, and make the other elements, NO_6, a compound radical, serving merely to give a distinctive character to the assumed functions of the H, I think you should adopt some other term to express the compound, $N.NO_6$, besides the hackneyed name *nitric acid;* and this is also the case when a salt of such an acid is spoken of.

BRITISH IRON AND STEEL OUTPUT IN 1930.

Production of pig iron last year averaged 516,400 tons per month, and that of crude steel 608,200 tons, as compared with 632,400 tous and 803,000 tons respectively in 1929. Furnaces iu blast at the end of 1930 numbered 76, as against 162 at the close of the previous year.

MELLON INSTITUTE ANNOUNCES INDUSTRIAL FELLOWSHIP ON SUGAR.

Dr. Edward R. Weidlein, Director, Mellon Institute of Industrial Research, has announced that the institution has lately begun a broad investigation into possible industrial uses for raw and refined sugar. The research will be carried on by a Multiple Industrial Fellowship that will be sustained by The Sugar Institute, Inc., of New York, an organization that represents the cane sugar refiners of the United States.

The comprehensive programme of investigation will be supervised by Dr. George D. Beal, Assistant Director of Mellon Institute, and by Dr. Gerald J. Cox, Senior Industrial Fellow. They and the scientists who will be under their direction in endeavouring to find and to develop uses for sugar in various industries will have the close advisory collaboration of Dr. Leonard H. Cretcher, the sugar specialist who is the head of Mellon Institute's Department of Research in Pure Chemistry.

According to Dr. Weidlein, various studies made by private research workers have already indicated results of industrial promise; these findings will be carefully studied in the laboratories of Mellon Institute. Most of these proposals relate to applications for sugar in such techuologic practises as wood preservation, textile finishing, and the manufacture of adhesives. Sugar is thought to merit searching investigation as a basic raw material in various branches of chemical industry.

Four chemists, headed by Dr. Cox, have begun the initial scientific research of the Industrial Fellowship. Additions will be made to this staff, as needed, from time to time.

BRITISH OVERSEAS TRADE IN 1930.

United Kingdom imports during last year were valued at £1,044.8 million, a decrease of £176 million from 1929. Exports amounted to £570.6 million, a decline of £158.7 million, while re-exports, at £87 millon, were £22.7 million less. To a very considerable extent these declines were due to the fall in commodity prices which has been so marked a feature of trade throughout the world since the autumn of 1929.

GENERAL NOTES

NEW FERTILISER PLANT IN BRITISH COLUMBIA.

The first unit of the new fertiliser plant of the Consolidated Mining and Smelting Company of Canada, Ltd., at Trail, B.C., is likely to be in partial operation next spring, at least so far as the superphosphate plant is concerned. It will, however, be some time later before the other fertiliser products such as ammonium sulphate and ammonium phosphate are being produced.

The whole layout consists of a group of administrative buildings and workshops on a 137-acre site known as the Warfield Flat at Tadnac, overlooking the great metallurgical industries at Trail. The administrative buildings include a soil research laboratory already engaged in important studies of the soils of the Prairie Provinces and elsewhere, in order to determine their precise requirements in the matter of fertiliser. There is also an assay office. In the manufacturing section of the new plant there is a hydrogen plant at the outer end of which is the mercury arc rectifier installation, a central plant called the " nitrogen plant "; and the ammonia plant.

Next spring an ammonium sulphate plant capable of producing 150 tons daily will be built. Between the hydrogen and nitrogen plants there will be erected three huge cylindrical gas containers 55 feet, 60 feet and 90 feet in diameter, the largest of which will receive and store under pressure gas from the hydrogen plant. The smallest will store nitrogen and the one of medium capacity will hold a mixture of these two gasses from which the ammonia will be made. The hydrogen plant will produce hydrogen by the electrolysis of water, while in the nitrogen plant air will be liquefied, separating the nitrogen from the oxygen. In the ammonia plant the mixture of gases consisting of one part of nitrogen to three of hydrogen, will be compressed under 4,500 pounds pressure and passed through a heated catalyst resulting in the production of anhydrous ammonia. Until the ammonium sulphate plant is ready to carry the manufacturing process still further, the ammonia plant will not be brought into operation.

The hydrogen plant measures 285 feet in length by 125 feet in width, its principal feature being the mercury arc rectifier plant converting alternating electrical current into the direct current needed for the hydrolysis of water. This section of the plant is the largest installation of its kind on the continent, exceeding by 20 per cent. the previous largest erected last year by the Consolidated Mining and Smelting Company at Tadanac in connection with its zinc fuming plant.

In the new nitrogen plant there will be housed the installation necessary to produce nitrogen from the atmosphere by the Claude liquid air process.

In another section of the manufacturing area are situated the operations connected with phosphate, the first of which is the large phosphoric acid plant in which superphosphate fertiliser will be produced by the application of sulphuric acid to phosphate rock brought from Fernie or Crow's Nest in British Columbia, or from other sources of supply. The plant is designed to turn out 300 tons of triple superphosphate per day, and will utilise in the treatment of phosphate rock the sulphuric acid produced from smelter gases at the Tadanac metallurgical works.

Belt conveyors will take the superphosphate to a huge storage structure 460 feet in length, 105 feet in width and 40 feet in height. Rapid progress is being made in the construction of this building, for which an immense amount of excavation work was found necessary, 55,000 cubic yards of earth being removed for the bins extending 25 feet below ground level. This huge storage accommodation is required in view of the fact that the distribution of fertiliser will be mainly carried on during the spring months, thus necessitating nine months' storage.

The chemical fertiliser plant will utilise between 35,000 and 40,000 h.p. of electrical energy when it reaches its first-unit stage, most of the power going to the mercury arc rectifier installation. Power will be developed by the West Kootenay Power and Light Company, Ltd., a subsidiary of the Consolidated Mining and Smelting Company, and received through a substation on the property.

WORLD SHIPPING POSITION.

Statistics issued by " Lloyd's Register of Shipping " shows 2,326,086 tons of shipping under construction throughout the world at the end of 1930. The proportion in Great Britain and Ireland is 39.1 per cent., or 908,902 tons, which is 651,352 tons less than was being built at the close of 1929.

THE CENSUS OF PRODUCTION, 1930.

A Census of Production is about to be taken by the Board of Trade relating to industrial production in the year 1930, and in the course of the next few weeks firms engaged in productive work throughout Great Britain will receive the forms they are required to fill up under the Census of Production Act. Firms were notified early last year of the particulars that would be required. and it is hoped that they will fill in accurately and send back promptly to the Census Office the forms now being sent out, in order that the results of the Censns may be published expeditiouslv. The previous Census was taken in 1924 .

OBJECTS AND USES OF THE CENSUS.

The primary purpose of the Census is to measure the quantity and value of the commodities making up the industrial output of the country. A measure of this output is of great utility to the business community, and for the guidance of Government policy. The Census figures also add value to other figures; for instance, it is only by comparison with figures of production that the full signficance of the returns of imports and exports can be seen. Again, the figures provide the means of comparing the relative importance, and the changes in relative importance, of the different industries on the basis of value of outnut, numbers employed and power of engines installed, and also afford a basis for estimating the national income. Industry is a living organism which is constantly changing in its structure and growth, and in the relative importance of its various parts; by comparison of the results of successive Censuses, the growth and change can be effectively measured, and changes in the output per worker and in the power equipment of industry can be examined. The changes in the geographical distribution of indnstry will also be shown, utilising the regional data secured for the first time in 1924. It may be recalled that the Board of Trade have recently been publishing quarterly figures regarding the variations in volume of the industrial output of this country, based on the 1924 Census; these index figures represent directly or indirectly about two-thirds of the industrial production of the country, but there is necessarily an unknown margin of uncertainty which may increase as the years pass. The new Census will provide the opportunity of estimating on a far more accurate basis the changes which have taken place compared with 1924 in the volume of the country's industrial output, and will provide a new starting point for estimating the quarterly index figures of production, as well as a basis for testing and adjusting the structure of those indices.

THE SECRECY OF RETURNS.

The returns made by firms are not communicated to any other Government Department or to any other person outside the staff specially sworn to secrecy under the Census of Production Act; the returns are only used in the compilation of totals of a general character which must not dis close the business of individual firms. The improper communication to any person of any individual return or part thereof would be visited with severe penalties on both the giver and the receiver of the information.

LOOKING FORWARD.

In the realm of industry, the year that has passed has been a year of gloom. World-wide trade depression, with its concomitant unemployment and personal hardship, has appeared to be its most prominent feature. Gloomy reports and dark forebodings have been spread throughout the land; even the technical Press, or at any rate some sections of it, has reflected the same spirit, and the world has almost lost confidence in its power of resuscitation.

What should be our message after such a year? "Things are not always as bad as they seem." If the sale of nickel is an index to the state of trade, as it well may be, at any rate, so far as the engineering trade is concerned, the industries of Great Britain have shown only a comparatively small falling off from the "boom" year of 1929 and have done actually more business than in 1928. In several industries the sales of nickel reflect a substantial advance, even over 1929.

The year 1930, too, witnessed no halt in the march of scientific and industrial development. The pages of this journal have recorded new discoveries in the laboratory, new conquests of the air, new achievements at sea and on land. These have been by men and women with a forward look—with hope for the future.

And if things have not been so bad as they have seemed, may they not, in the future, be better than we expect

Confidence is all that we need.—*The Nickel Bulletin.*

NEW USE FOR PYRITE.

Pyrite now enables the Couranian newsprint industry to discontinue the purchasing of a large quantity of foreign sulphur.

In addition to direct savings to the newsprint and chemical industry amounting to about $1,600,000 a year, the by-product of this process, iron ore, would supply one-eighth of the total annual iron ore requirements of Ontario and Quebec.

The idea of using pyrite is not new. In fact, pyrite was the common source of sulphur before the discovery of the great brimstone deposits in the south western part of the United States. Even in 1928 the amount of pyrite produced was the equivalent of 3,300,000 metric tons sulphur, while brimstone production amounted to only 2,560,000 metric tons. Since it takes 2.2 tons of pyrite to be equivalent to 1 ton of sulphur, the total world production of pyrite in 1928 was 7,300,000 metric tons. Under the methods in common use before the Freeman burner was developed the cost was so high, and the equipment so complicated that there had been no idea of substituting Canadian pyrite for foreign brimstone.

Pyrite is a mineral made up largely of iron and sulphur. In the past the sulphur content has discouraged those who wished to secure iron from this source.

F.B.I. PRESIDENT ELECT.

Sir James Lithgow's Second Year. Deputy President Nominated.

At the Meeting of the Grand Council of the Federation of British Industries, Lieut.-Colonel Sir James Lithgow, Bart., was nominated for a second year's office as President.

It was further decided to recommend that Sir Arthur Duckham, G.B.E., K.C.B., M.I.C.E., M.I.M.E., should be elected Deputy President for the ensuing year with a view to his succeeding Sir James Lithgow as President in 1932.

It was decided to recommend the re-election of the existing Vice-Presidents, and, in addition, Sir Herbert Austin, K.B.E., Sir G. Beharrel, D.S.O., Sir William Morris, Bart., Mr. A. H. Pollen and Mr. G. E. Rowland.

These nominations will come up for election at a General Meeting of the Members of the F.B.I. later in the year.

SIR ARTHUR DUCKHAM, G.B.E., K.C.B., M.I.C.E., M.I.M.E.,

Record of F.B.I. Deputy President Elect.

Sir Arthur Duckham was born in 1897 and at an early age entered the Engineering workshops, where he served his time specialising in furnace work, carbonisation of coal, and engineering connected with chemical development. He has devised and patented schemes on these subjects.

During the war he was a Member of the Council of the Ministry of Munitions, a Member of the Air Council, and Director General of Aircraft production.

After the war he served as a Member of the Sankey Coal Commission in 1919. In 1929 he visited Australia as Chairman of the British Economic Mission, and he is Chairman of the Standing Committee on Mineral Transport.

He is a Director of Woodhall, Duckham, Ltd., and several industrial, chemical and coal bye-product companies.

He has travelled widely in connection with various engineering schemes and has a very extensive knowledge of Industry, both in this country and abroad.

TENDER FOR MEDICAMENTS LABORATORY SUPPLIES, ETC., FOR PORTUGUESE WEST AFRICA.

The Commercial Secretary to His Majesty's Embassy at Lisbon reports that the Public Health Department, Loanda, is calling for tenders, to be presented in Loanda by the 6th February, for the supply of medicaments, laboratory supplies, etc., during the year 1931-1932.

Firms desirous of offering materials of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number F.X. 1001 should be quoted.

ZINC.

Some idea of the magnitude and importance of the metal zinc is obtained when it is realised that the world's annual production amounts to about 1,400,000 tons, nearly forty countries contributing the necessary ores, while over twenty carry on smelting of zinc.

A full general account of the zinc industry is given in "Zinc," the latest of the series of monographs issued by the Imperial Institute.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, January 15.

The following papers were read :—

Iridescent Colours of Birds and Insects. By LORD RAYLEIGH, F.R.S.

The reflexion spectra of various brilliantly coloured insects are examined in the ultra-violet. *Morpho* butterflies and *Urania* moths are found to show ultra-violet maxima in general agreement with the theory of interference. In *Morpho achilles* the positions of the ultra-violet maxima indicate that the blue colour is due to a reflexion of the second order. Spectra are reproduced.

Contrary to some previous accounts, no *Morpho* butterflies are found to show their blue colour by transmission. They do show brilliant diffraction spectra by transmission, when snitably mounted in balsam, but these have nothing to do with the blue reflexion.

Iridescent beetles showing a deep red colour at normal incidence may be made to pass through all the colours of the spectrum to violet, provided that arrangements are made to annul refraction at the air-chitin surface so as to obtain very oblique incidence without. This is in sharp contrast to the surface reflexion of aniline dyes, which do not show much change of colour with incidence.

Some of the golden beetles show transmission spectra of bands corresponding to the reflexion spectra formerly described. These bands vary continuously in position with the part of the specimen examined. It seems impossible to interpret this reasonably except on the theory of interference. The transmission bands of chemical substances do not vary from one sample to another. The spectra are reproduced.

Moist chlorine gas does not destroy the colours of *Morpho* or of *Urania*, though the black background is bleached. Nor does chlorine decolourise the metallic beetles. The colours of all kinds of feathers, however, are rapidly discharged.

Peacock feathers undergo a progressive change of colour in ultra-violet light or long-continued sunlight. Generally speaking, the colours become more refrangible.

Other feathers (*e.g.* parrot) even when blue are slowly decolourisen without change of refrangibility. *Morpho* butterflies and *Urania* also lose colour without change of refrangibility.

Although, *prima facie*, facing under light or chlorine in these cases would seem to favour the idea of a pigment, it is not considered that this view can be maintained. The fading must rather be attributed to the breaking down of an interference strncture. It remains unexplained why the progressive change of tint seen in peacock feathers are not seen in the other cases examined.

The generalisation seems to hold good, however, that colour which is stable in chlorine is certainly *not* due to pigments.

The Emission of Electrons under the Influence of Chemical Action at Lower Gas Pressures. By O. W. RICHARDSON, F.R.S., AND L. G. GRIMMETT.

A method is described by which partial pressures of phosgene can be controlled and their changes measured down to 10^{-5} mm. Hg. The electron emission from NaK in this gas has been measured down to directly measured pressures of 10^{-5} and to extrapolated pressures of 5×10^{-7} mm. under various conditions. In contrast to the results at pressures above 10^{-3} mm., the emission is now found to he a function of the gas pressure as Richardson originally supposed. This function is determined by the experiments. Evidence is also brought forward to show that the experimentally determined velocity distribution function among the electrons approaches a limit as the pressure is reduced.

The Hardening of Metals by Rotating Magnetic Fields. By E. G. HERBERT. Communicated by W. Rosenhain, F.R.S.

The following papers were read in title only :—

The Sorption of Carbon Tetrachloride at Low Pressures by Activated Charcoals. Part IV. By A. J. ALLMAND, F.R.S., AND A. PUTTICK.

This paper contains an account of experiments designed to clear up certain matters left doubtful as the result of earlier experiments (Parts II and III).

Work has been done on the effect of high temperature evaluation on the nature of vapour isothermals on charcoal. The results obtained, more particularly those given by charcoals thds treated and then exposed to air hefore the determination of the isothermal, indicate the correctness of the views already put forward concerning the rôle played by adsorbed oxygen.

It has further been found, as the result of a detailed examination, taking a large number of experimental points within a comparatively small pressure range, that the carbon tetrachloride isothermal on at least one charcoal has a discontinuous structure. This confirms previous work carried out in this laboratory by another technique.

Evidence has been brought to show that, if a sufficiently high charging pressure of sorbate is used, a reversible isothermal can be obtained.

The soundness of the pressure readings given by the Pirani gauge technique has been established.

The Eddy System in the Wake of Flat Circular Plates in Three Dimensional Flow. By D. Marshall and Sir Thomas Stanton, F.R.S.

The paper describes experiments on the Flow of water in steady motion past flat circular plates normal to the direction of motion. The nature of the flow is rendered visible by colouring the streams and simultaneous photographs on two planes at right angles of the motion in the wake of the plates were obtained.

At speeds lying between a well-defined upper limit and a lower limit well above that corresponding with a state of flow in which the inertia terms are negligible, a permanent vortex ring was observed at the back of the plate. When the speed exceeded the upper limit the substance of the ring was discharged downstream in a series of vortices of definite pitch and periodicity.

Artificial Disintegration by α-Particles. By J. Chadwick, F.R.S., J. E. R. Constable and E. C. Pollard.

The protons emitted by certain elements when bombarded by α-particles have been examined by an electrical method. Polonium was used as the source of α-particles, and the emitted protons were observed both in the direction of the incident α-particles and at right angles to it.

It was found that, except in the cases of fluorine and sodium, the disintegration protons consisted of distinct groups. The origin of these groups is explained on the assumption that the protons and α-particles contained in a nucleus are in definite energy levels. Information about the position of these levels is obtained from an examination of the experimental results. The mass defects of certain nuclei formed in the disintegration processes are deduced. Some points of general interest in the problem of artificial disintegration are discussed.

The Combination of Nitrogen and Hydrogen Activated by Electrons. By G. F. Brett. Communicated by A. P. Chattock, F.R.S.

The Chemical Constant of Hydrogen Vapour and the Entropy of Crystalline Hydrogen. By T. E. Stern. Communicated by R. H. Fowler, F.R.S.

Quantum Mechanics of Electrons in Crystal Lattices. By R. de L. Kronig and W. G. Penney. Communicated by R. H. Fowler, F.R.S.

The Symmetrical Spherical Oscillator and the Rotational Motion of Homopolar Molecules in Crystals. By T. E. Stern. Communicated by R. H. Fowler, F.R.S.

The Scattering of Hard Gamma Rays. II. By L. H. Gray. Communicated by Sir Ernest Rutherford, F.R.S.

Fine Structure in the Mercury Singlet Terms. By S. Tolansky. Communicated by T. H. Havelock, F.R.S.

THE CHEMICAL SOCIETY.

Thursday, January 15.

Salt-forming Characteristics of Doubly and Singly Linked Elements of the Oxygen Group. Part I. The Carbonyl Group in Benzaldehyde and Acetophenone. By J. W. Baker.

The intensely coloured solution formed by benzylidene-*m*-nitroaniline in concentrated sulphuric acid or oleum solution has previously been shown (*J.*, 1930, 431) to be due to the presence of the salt PhCH : $NRH.HSO_4$. Since benzaldehyde and acetophenone form similar intensely coloured solutions it is suggested that they exist, in sulphuric acid solution, in the form of the less stable oxonium salts of the type PhCR : $OH.HSO_4$. Preliminary physical evidence, derived from partition experiments (between ligroin and sulphuric acid) and colorimetric investigations on solutions in sulphuric acid of various concentrations, is adduced in support of this view. The effect of the addition of ammonium sulphate on the ionic equilibria in such solutions is discussed.

Part II. The Nitration of Benzaldehyde and Acetophenone in Sulphuric Acid Solution. By J. W. Baker and W. G. Moffitt.

The conclusions already reached from physical data (preceding paper) concerning the existence of benzaldehyde and acetophenone as oxonium salts in sulphuric acid

solution have been confirmed by a study of the proportions of the *m*-nitro-derivative formed by nitration of these compounds in the presence of sulphuric acid of various concentrations. The presence of the positive charge on the cation PhCR : OH of the salt form causes a considerable increase in the proportion of m-nitration observed under these conditions. Thus in sulphuric acid containing 7.3 per cent. of free sulphur trioxide benzaldehyde and acetophenone afford 90.8 and 90.0 per cent. of the *m*-nitro-isomeride, respectively. The proportion decreases gradually as the concentration of the sulphuric acid is diminished until in 80 per cent. sulphuric acid the values are 83.9 and 83.1 per cent. of *meta*, respectively. Moreover, in all cases, the addition of ammonium sulphate to the nitrating medium causes a depression in the amount of the *m*-isomeride formed, comparable in both magnitude and type to that observed in the case of the ψ-base benzylidene-*m*-nitroaniline, thus proving that substitution occurs mainly through the cation of the oxonium salt. The formation of a loose salt-like complex, even in nitric acid alone, is suggested by the slight fall in the proportion of *m*-nitration.

10-Chloro-5 :10-Dihydrophenarsazine and its Derivatives. Part XIV. Chloro-Derivatives. By L. A. Elson and C. S. Gibson.

A systematic study of the condensation of eleven new chlorine substituted diphenylamines with arsenious chloride has been made.

Condensation proceeded in all but four cases, and these were when the substituted diphenylamine has a chlorine atom in an *ortho*-position to the :NH group. The two possible isomeric componnds, produced by the condensation of arseuious chloride and 3 : 4′-dichlorodiphenylamine, and also the two isomeric compounds, produced by the same reaction from 3 : 4-dichlorodiphenylamine, have been isolated.

The bearing of these results both on the mechanism of the condensation of arsenious chloride and diphenylamine and on the constitution of the homogeneous product obtained from the condensation when two isomeric compounds are theoretically possible is discussed.

The Essential Oil of Backhousia angustifolia. *Part III. The Constitutions of Angustione and Dehydroangustione.* By R. S. Cahn, C. S. Gibson, A. R. Penfold, and J. L. Simonsen.

Additional evidence of the correctness of the constitution previously assigned to angustione is that this ketoue (i) on oxidation with potassium hypobromite solution yields *l*-ααγ-trimethylglutaric acid in quantitative amount, and (ii) on oxidation with potassium permanganate yields a liquid acid, which on further oxidation is converted into *l*-ααγ-trimethylglutaric acid.

THE PHYSICAL SOCIETY.

At the meetiug on January 16 the following papers were read :

The Influence of Low Temperatures on the Thermal Diffusion Effect. By T. L. Ibbs, M.C., Ph.D., and K. E. Grew, Ph.D.

Measurements of thermal diffusion on the following gas mixtures at temperatures between 15° C., and −190° C. are described : He—Ne; H_2—Ne; He—A; Ne—A; He—N_2. The experiments confirm and extend the authors' previous work showing that there is a general tendency for k_t to decrease at low temperatures. It is found, however, that for the pairs of gases He—Ne and H_2—Ne, with low liquefying points, the change in k_t between 15° C. and −190° C. is small. Chapman's theory is used to deduce approximate values of the laws of repulsive force operating between molecules during collisions. At low temperatures molecules tend to become "softer" and their behaviour is less likt that of rigid elastic spheres. The "hardest" molecules appear to show the smallest variation in k_t. The influence of helium in this respect, on the value of k_t for a mixture, is clearly shown.

Further Experiments on Magnetostriction Oscillators at Radio-Frequencies. By J. H. Vincent, M.A., D.Sc., F.Inst.P.

Work on magnetostriction oscillators at radio-frequeney is continued from a previous paper. It is shown that the coil surrounding the bar can be in either branch of a simple tuned anode circuit. When the bar-coil is in the inductive branch the circuit mav be operated as a series or parallel arrangement; in the latter case the direct plate-current does not pass through the inductive branch of the fly-wheel circuit. The variation in either the anode- or the grid-current can be used to indicate resonance. Comparative experiments with corronil, nickel and glowray suggest that glowray is the most suitable of these materials for high-frequency oscillators. The experi-

ments are carried on to the case of a glow-ray oscillator 1.9 mm. long which has a frequency of 1280 kc./sec. and weighs less than a fiftieth of a gramme.

The Equivalent Circuit of the Magnetostriction Oscillator. By S. BUTTERWORTH, M.Sc., AND F. D. SMITH, M.Sc., A.M.I.E.E.

The Joule effect in magnetostriction is defined by the relation $S = \lambda B$, where S is the stress produced by a small increment of induction B of an existing induction B_0; and the converse effect by the relation $H = \kappa\xi$, where H is the magnetic field produced by a small strain ξ. Conservation of energy requires that $\kappa = 4\pi\lambda$. These equations are used in investigating the motion of a magnetostriction oscillator consisting of a closed circular ring inside a toroid, eddy currents and hysteresis being taken into account. It is shown that the oscillator can be represented by an equivalent electrical circuit comprising a paid of parallel impedances Z_e, Z_m, in series with an impedance Z_1, where Z_1 represents leakage impedance and Z_e impedance due to core flux in the absence of motion, while Z_m is a resonant shunt to Z_e and represents the effect of the motion. Expressions for the elements of the circuit in terms of the fundamental constants of the material are given. The circle-diagram of impedances is deduced, and the modifying effects of eddy-currents and hysteresis are investigated. Some simple geometrical relations between the vectors in the diagram are derived. It is shown that the size of the circle diagram for solid material having a large value of λ depends mainly upon permeability and resistivity and only slightly upon λ, and that a high degree of resonance may be associated with poor magnetostriction quality; the circle-diagram may, in fact, lead to erroneous conclusions unless interpreted in the light of an adequate theory. An experimental investigation of the resonant radial vibrations of solid and laminated nickel rings verifies the theoretical deductions and leads to numerical values of λ and κ in agreement with values deduced from the work of Masumoto and Nara and of McKeehan and Croffi. For nickel in the annealed state, $\lambda = 1.76 \times 10_4$ and $\kappa = 22.1 \times 10^4$ at a point on the curve corresponding to $H_0 = 14.5$ gauss.

The Theory of the Microscope. By L. C. MARTIN, D.Sc., A.R.C.S., D.I.C.

The paper examines the diffraction-effects produced by (*a*) two adjacent apertures, and (*b*) a series of apertures in an opaque screen situated in the focal plane of a lens system, when the illuminating system is projecting the elementary image of a point-source of light into this object plane. The diffraction-effects and geometrical resolving power of the grating are shown to be independent of the concentration of the light in the object plane; they depend rather on the number of apertures free to transmit light. The theory is then extended to the case where the illumination of the object is produced by a source of finite area. Both the equivalence and Abbé principles appear in the analysis of the mode of formation of the image in such critical illumination, but subject to the difficulties encountered in integration for the effects of finite sources of light. Confirmatory experimental work is in hand.

MINERALOGICAL SOCIETY.

Thursday, January 15.

Sir John S. Flett, President, in the chair.

On a Soda-Margarite from the Postmasburg District, South Africa. By DR. F. COLES PHILLIPS.

A fuller description is given of material first described by Dr. A. L. Hall. The mineral occurs in mica-like crystals associated with the Postmasburg manganese ores. The Physical properties described resemble in general those of a mica, but analyses show 50 per cent. of alumina and 10 per cent. of alkalies, with little lime. It is best described as soda-margarite; in composition it resembles the "ophesite" of J. Lawrence Smith.

On the Distinction of Analcime from Leucite in Rocks by X-ray Methods. By F. A. BANNISTER.

Powder-photographs of phenocrysts in blairmorite from the Lupata Gorge, Zambesi River, Portuguese East Africa, are shown to be identical with those for analcime and not for leucite. The icositetrahedral outlines of the analcime phenocrysts found in the rock strongly suggest their primary origin. The X-ray photographs indicate that the phenocrysts are not single crystals but consist of aggregates of particles in sub-parallel position.

On a Chemical, Optical and X-ray Study of Nepheline and Kaliophilite (with chemical analyses by Mr. M. H. Hey). By F. A. BANNISTER.

Correlated data have enabled the author to prove the approximate constancy of the

number of oxygen atoms in the unit cells of several nepheline and elæolite specimens. Thence the numbers of atoms of each kind per unit cell have been counted. The cell volumes and optical properties have also been related to the chemical composition. An approximate structure is suggested which together with the chemical work explains the variable composition of nepheline. Kaliophilite is shown to possess a much larger cell than that of nepheline and its Lauegram exhibits higher symmetry. "Pseudonepheline" (rich in potassium) has a slightly greater cell volume than normal nepheline, but its Lauegram is almost identical and its axial ratio the same.

On an Occurrence of Grunerite at Pierrefitte, Hautes-Pyrénées, France. By Dr. H. V. Warren.

A grunerite-schist, consisting almost entirely of fibrous grunerite, occurs at the Pierrefitte mine, where needles of the same mineral also occur in the galena and blende of the ore-bodies. The grunerite is associated with a carbonaceous schist and with magnetite, and encloses specks of carbon. Analyses of grunerite by E. G. Radlay (I from schist, II from ore) :—

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO
I	46.42	0.14	0.28	0.00	42.60	2.23
II	49.11	0.12	1.81	2.03	38.98	0.79

MgO	CaO	Na_2O	K_2O	H_2O	C	
3.12	1.51	0.70	0.43	1.92	0.65	=100.07
2.97	0.75	0.94	0.64	1.49	0.31	= 99.96

Cleavage perfect {110}; (110) : (110)=53° 55′ to 54°55′. Plane of optic axes (010); 2V=84°15′. Refractive indices : $\alpha=1.676$, $\beta=1.693$, $\gamma=1.707$ (Na). Birefringence —; extinction on (010)=13°22′=c' :γ

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Studies on the Adsorbed Moisture in the Kanbara Clay (concluded). By Hajime Isobe.

Sinomenine. XIX. Reduction of Sinomenine and Hydrosinomenine by Sodium Amalgam. By Kakuji Goto and Shingo Mitsui.

Sinomenine. XX. Benzene-azo-sinomenine. By Kakuji Goto and Hideo Shishido.

Sinomenine. XXI. The Reaction between Sinomenine and Formaldehyde. By Kakuji Gotô, Hideo Shishido and Reikichi Anaba.

The Essential Oil of Artesisia capillaris, Thunb. I. By Junzo Arima and Teiji Okamoto.

The Determination of Titanium, Tin and Lead. (Studies on Gravimetric Analysis by Means of the Thermobalance. VII.) By Kaneyasu Murayama.

The Catalytic Action of Active Carbon. I. The Catalytic Action of Active Carbon on Menthone and Piperitone. By Seizo Kimura.

CORRESPONDENCE.

FOREIGN MATERIALS USED ON BRITISH ROADS.

To the Editor of "Chemical News."

Sir,

I trust you will allow me to correct a popular misconception to which you give credence in a paragraph entitled "Foreign materials used on British roads" which appeared in your issue of December 26. 199,476 tons of "bitumen and asphalt" were stated to have been imported into this country during 1929, representing an increase of some 12,000 tons over 1928.

In common with all other definitions used in official statistics, the term "bitumen and asphalt" is used in the Board of Trade returns in a very technical and not generally understood sense. Actually the figure of 199,476 tons includes over 65,000 tons of Rock Asphalt, which contains only from 4 to 10 per cent. of bitumen, as well as some 10,000 tons of Wurzilite, Gilsonite, Stearine Pitch and similar substances, which are used in the paint, varnish and other trades and for which there is no substitute. A further 53,000 tons was imported from the British colony of Trinidad and on this the British Government receives a substantial royalty, while another 7,000 tons was re-exported. Only a small proportion of the 199,476 tons can therefore correctly be classed as foreign bitumen for road use, and this forms an even smaller proportion of the total of 400,000 tons of bitumen which is annually used on British roads; the great bulk of bitumen used for roads is, of course, manufactured in this country.

The increase of 12,000 tons which was recorded is largely accounted for by a rise in imports from Trinidad from 45,000 tons in 1928 to 53,000 tons in 1929. Incidentally it is quite wrong to speak of the "Minister of Transport's plea for the more general use of British tar for British roads," since the

Minister's circular referred to naturally did not specify any particular material and it applies equally to home and Empire-produced bitumen.

Your faithfully,
LEONARD A. RICH.

43, Park Street,
Stoke Newington, N.16.
2 January, 1931.

NOTICES OF BOOKS.

Dejiny Novin v Cechách (History of the Press in Bohemia). By JOSEF VOLF. Pp. 231 + 35 Plates. Prague: Nákladem Vydavatelstva Ducha Novin. 1930. Price 24 crowns (3s.).

When did periodical literature begin? An attempt to decide this question, so far as Czechoslovakia is concerned, has been made by Dr. Volf in his valuable and fully illustrated and documented *History of the Press in Bohemia* up to the year 1848.

From his researches we learn that news circulated at least as early as 1400, *i.e.*, long before the advent of printing. The oldest Czech manuscript newspaper extant is one from Jindrichův Hradec, dated 1495.

In the latter half of the 16th century a number of news sheets made an ephemeral appearance, their information being chiefly connected with wars and the troublous times then pressing upon the peoples of Central Europe. The early periodicals and "Diaria" of the 17th and first half of the 18th centuries were distributed by a postal system and consequently many bore such titles as *Post-Zeitung*, *Postilion* and *Postovské Noviny*. Owing to the repressive measures of the counter-reformation of the 17th century after the Czechs lost their independence in 1620 many valuable books and manuscripts of great scientific and general interest were destroyed.

Among the many notes given in the appendix is one mentioning a whole series (over 100) of European journals in many languages which were to be bought at Schonfeld's shop in Prague in 1788. Of the newspapers cited a few naturally chronicled some of the more striking of the scientific discoveries of the times, although, as to-day, the newspapers did not devote very special attention to the natural sciences.

J. G. F. DRUCE.

The Relative Values of Cod Liver from Various Sources. By PROF. J. C. DRUMMOND, D.Sc., AND PROF. T. P. HILDITCH, D.Sc. Pp. 129. London: H.M. Stationery Office (for the Empire Marketing Board, Queen Anne's Gate Buildings, S.W. 1930. Price 1s.

This shilling monograph deals with the researches of Profs. Drummond and Hilditch upon (1) the nature of the variations in the vitamin content of cod liver oils obtained from fish from different sources and (2) the methods of manufacture and refinement of medicinal cod liver oil. The therapeutic value of this oil has been traced to its content of Vitamin A and Vitamin D and this varies in oils of different origin, that from Newfoundland being found to be the richest.

The primary source of Vitamin A is the minute green plant life of the sea which forms the ultimate food supply of the animal life. Crustacea, the main food of the cod, are curiously deficient in both vitamins so that these accessory factors are either synthesised by the animal or, more probably, slowly accumulated in the liver from the small amounts in the fishes' food.

Generally speaking, there appears to be a parallel between the concentration of the two vitamins, *i.e.*, an oil rich in Vitamin A will also be rich in Vitamin D. The most satisfactory method of evaluating the oil in terms of vitamin activity should be its effect upon the growth of animals to which it is administered. The chemical determination is based upon the formation of a blue substance with arsenic or antimony chloride, the depth of colour is then measured with a Lovibond tintometer.

The authors make valuable suggestions concerning the manufacture and the desired standard of quality to be expected of marketable cod liver oil and it is to be hoped that their recommendations will be accepted.

We have received the comprehensive Price List of Fine Chemicals manufactured by The British Drug Houses Limited, Graham Street, City Road, London, N.1.

The list of chemicals include Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators, Solutions, Minerals and Dyes.

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Forthcoming Events.

ROYAL INSTITUTION.
21, Albemarle Street, W.1.

Friday, January 30, at 9 p.m.—" The First Defence of Gibraltar by the English, Oct., 1704—April, 1705." By G. M. Trevelyan, O.M., C.B.E., D.C.L., LL.D.

Friday, February 6, at 9 p.m.—" The Internal Mechanics of the Trade Slump." By J. M. Keynes, C.B., M.A.

THE INSTITUTE OF METALS.
BIRMINGHAM LOCAL SECTION.

Tuesday, February 3, at 7 p.m., in the Chamber of Commerce, Birmingham. — Discussion on " Refractories," to be opened by C. E. Moore and I. A. Bailey.

MANCHESTER CHEMICAL SOCIETIES.
INSTITUTE OF CHEMISTRY.

Thursday, February 5, at 7 p.m., in the Manchester Ltd., Royal Exchange.—Prof. F. L. Pyman, Ph.D., F.I.C., F.R.S.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

Friday, February 6, at 7 p.m., at Milton Hall, Deansgate.—Members' Evening.

INSTITUTE OF RUBBER INDUSTRY, AND SOCIETY OF CHEMICAL INDUSTRY.

Friday, February 6, at 7 p.m., at Engineers' Club, Manchester.—Joint Meeting.

(I) " Plant used in the Manufacture of Synthetic Resins." By Dr. E. E. Walker and E. Bevan.

SOCIETY OF PUBLIC ANALYSTS.

Wednesday, February 4, at 8 p.m., at Burlington House, Piccadilly, W.1.—Ordinary Meeting.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

109.—Bernhauer, K. — Production of organic compounds by biochemical action. January 1.

110.—Deutsche Hydrierwerke Akt.-Ges.—Manufacture of sulphonic acids. January 1.

132.—Ges. fur Linde's Eismaschinen Akt.-Ges.—Absorption of carbonic acid from gaseous mixtures. January 1.

Abstract Published.

338,187.—Aliphatic acids. Dreyfus, H., 22, Hanover Square, London.

Acetic, propionic, and other lower aliphatic acids are concentrated by extracting the aqueous solution with a solvent, and then adding a liquid such as a hydrocarbon or a halogenated hydrocarbon to the extract to precipitate the dissolved water, which is then removed in the liquid state. The solvent may be any of those mentioned in Specification 283,702, for instance ether, ethyl acetate, or acetone oil, and may be used in admixture with a hydrocarbon or halogenated hydrocarbon such as methylene chloride or carbon tetrachloride, and salts may also be used to limit the solubility of the solvent in water. The precipitant for the water in the extract may be petroleum distillates, benzene, carbon tetrachloride, chloroform, dichlorethylene, trichlorethylene, and acetylene tetrachloride; and the water-precipitating liquid may be the same as that used in admixture with the solvent. The extraction may be effected in a column in counter-current, and either or both liquids may be introduced into the column through sprays or nozzles; or the solvent may be admitted as vapour, and the tower may be packed with suitable filling and may be provided with a heating jacket. The precipitation of the water may be effected in a suitable mixing apparatus, for example, a packed tower or a vessel with an agitator. The precipitated water may be separated in a settling tank and may be further treated to recover its content of acid. The mixture of acid, solvent, and water-precipitant may be separated by distillation, and both the solvent and water-precipitant may form azeotropic mixtures with water, so that it is not necessary to precipitate and separate in liquid form all the water in the original dilute acid; and further water may be carried off by returning the condensate to the still after separating the aqueous layer. In an example, acetic acid of 30 per cent. strength is extracted in counter-current with ether as described in Specification 283,702. The extract, containing 30 per cent. water, is mixed with benzene, and the mixture lead to a separator, the non-

aqueous layer being treated in a column still, ether being distilled off, the residue being treated in a second still to remove the benzene, which carries off some acetic acid and any remaing water. Specification 320,606 is referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

CELLATEX.

517,316.—All goods in class 1 which includes chemical substances used in manufactures, photography, philosophical research and anti-corrosives.—New G. and S. Processes Syndicate, Ltd., Imrie House, 33 to 36, King William Street, London, E.C.4. January 7.

B511,031.—A Triangular label device bearing the letter S, and the word SANDOZ, Cleaning, reducing and softening agents, being chemical substances fo ruse in the manufacture of textile fabrics, dyes in class 1, chemical substances being intermediates used in the manufacture of dyes, and preparations for preventing rust on metals.—Chemical Works, formerly Sandoz, also trading as Chemische Fabrik Vormals Sandoz, and as Fabrique De Produits Chimiques Ci-Devant Sandoz, 60, Fabrikstrasse, Basle, Switzerland. January 7. (By Consent).

PERCHLORON.

514,549.—Chemical substance containing hypochlorites and adapted to be used for agricultural, horticultural, veterinary and sanitary purposes. —I. G. Farbenindustrie Aktiengesellschaft, 28, Mainzer Landstrasse, Frankfort-on-the-Main, Germany. January 7 (Associated).

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or *How to Reason Correctly*. By J. E. Roscoe, M.A., Oxon.

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By the Rev. J. E. Roscoe, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

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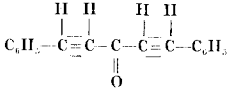
CONTRIBUTION TO THE CHEMISTRY OF DIBENZALACETONE. A NEW MOLECULAR DERIVATIVE OF DIBENZALACETONE AND $CuCl_2$.

By GEORGE BACHARACH AND LEO K. YANOWSKI.

Chemistry Department, Fordham University, New York.

Dibenzalacetone affords some very interesting results concerning addition reactions. It takes on one or two molecules of HCl forming compounds which are easily decomposed by water giving back the original ketone. The mono-chlorhydrate is light yellow while the di-chlorhydrate is dark orange-red. This proves to Strauss[1] that there are at least two positions where whole molecules of an acid can be added, and since with the addition of the second molecule, a darkening takes place, it demonstrates to him that the double bonds are unaffected and that the addition is brought about by auxiliary valences at the oxygen and carbon :



Other substances, such as salts, have in the past been attached to the molecule of dibenzalacetone and compounds of the following type were obtained : $C_{17}H_{14}O.HCl.HgCl_2$, $C_{17}H_{14}O.HCl.FeCl_3$, etc. One notices the simultaneous presenee of HCl, but additive compounds of dibenzalacetone and the salt alone were also reported. We refer here to the literature published by Walden[2] and Vorlaender and Hayakawa[3].

THE CHEMICAL NEWS

Readers are reminded that the subscriptions for 1931 are now due and should be sent to

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Merton House,
Salisbury Square.
London, E.C.4., England.

We noticed that an additive product with $CuCl_2$ could only be obtained when dry HCl gas was passed through the flask containing 2.5 gms. of dibenzalacetone, 2.8 gms. of $CuCl_2$ and 80 c.c. of anhydrous ether. To this effect we heated the mixture on a water bath in a flask surmounted by a reflux condenser and kept it in a state of mild boiling for several hours, allowing a stream of dry HCl gas to pass through continuously. At the end of some three hours almost all the $CuCl_2$ had gone in solution, a thing which was impossible when no HCl had been used. Upon evaporating the ether solution reddish-brown crystals appeared which, after several recrystallisations, showed a melting point of 64-65°C. An analysis demonstrated that it had the percentage composition consistent with the formula: $C_{17}H_{14}O.2HCl.2CuCl_2.2H_2O$. This fact was further corroborated by the molecular weight of 612.27

ANALYSIS:

Found:

	%
Cu	20.96
C	33.47
H	4.18
Total Cl...	34.39
Cl as HCl (titrated in water solution)	11.73
H_2O	5.80

Calculated:

	%
Cu...	20.78
C	33.34
H	4.27
Cl	34.81
Cl as HCl	11.59
H_2O	two mols

Molecular Weight:

Found for $C_{16}H_{14}O.2HCl.2CuCl_2$.

$2H_2O$	612.27
Calculated	611.87

When the substance is shaken at ordinary temperature with water and the mixture is filtered, the filtrate is acid and a titration shows an amount of Cl consistent with two molecules of HCl; deducting this amount from the percentage of total Cl, the balance corresponds to the one of two molecules of $CuCl_2$. Chlorine is, therefore, attached in two forms.

CONCLUSIONS:

(1) A new molecular derivative of dibenzalacetone was prepared whose formula is: $C_{17}H_{14}O.2HCl.2CuCl_2.2H_2O$.

(2) The attachment of $CuCl_2$ to dibenzalacetone is only possible by the simultaneous action of dry HCl.

(3) The compound, when exposed to air takes on moisture and attaches two molecules of water of crystallisation.

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THE COLOUR REACTION OF JAPANESE ACID CLAY UPON CAROTIN.

By K. KOBAYASHI, K. YAMAMOTO AND J. ABE.

Japanese acid clays, previously dried at 100°—150°C. give a beautiful blueish-green colour reaction upon carotin benzol solution. In our previous report, on the colour reaction of the Japanese acid clays upon liver oils, vitamin *A* on the market (J. Soc. Chem. Ind., Japan 1924, 937—944, 1061—1067) we reported that the colour reaction of acid clay upon liver oil etc. is just parallel to that of conc. sulphuric acid. In this experiment the colour reaction of acid clay upon carotin is in the same relation.

The colour reaction upon benzol solution of carotin wa studied with 35 samples of clays, 15 being samples of Japanese acid clays, 3 of Florida earths, 1 of fuller's earth. Pure carotin crystals from carrot have been prepared by the method of Escher.

Quantitative examination of the colour reaction has been performed by the colorimetric method of Willstätter and Stoll. In this examination the standard solution of potassium dichromate was used.

Benzol, carbon tetrachloride and petroleum ether are the suitable solvents for the clay colour reaction, but in the case of alcohol and ether results are poor.

Conc. phosphric acid, anhydrous aluminium chloride and anhydrous zinc chloride give the same colour reaction upon carotin as Japanese acid clay does. On this point the colour reaction of these reagents upon carotin resembles to that of these reagents upon liver oil and vitamin *A*.

Japanese acid clay, dried at 150°C. two hours, acquires the most intense activity with regard to the colour reaction.

LABORATORY CONCENTRATION OF THE MISSOURI IRON ORES OF IRON MOUNTAIN AND PILOT KNOB.

By F. D. DeVaney and S. R. B. Cooke.

School of Mines and Metallurgy, University of Missouri.

Two types of ores found associated with the igneous intrusions of South-east Missouri were studied to determine their amenability to concentration. Reserves of both ore deposits are large but both ores are too siliceous to be of value with beneficiation.

Petrographic studies as well as float-and-sink tests were made on each ore to determine its character. The results showed that high-grade concentrates accompanied by high recoveries would be difficult to obtain on either ore by gravity methods. Magnetic roasting tests were performed, and magnetic concentration methods were applied to the roasting ores. The results were encouraging and the optimum condition for carrying on the roasting operations and the magnetic concentration process were worked out.

The conclusions from the study of the Pilot Knob ore were that the locking between the iron minerals and the gangue was such that crushing to at least 150 mesh would be necessary to give a fair liberation. Gravity concentration would be impractical. Due to the fineness of the hematite and the porosity of the ore magnetising roasting is easily performed. Magnetic concentration of roasted ore finer than 150 mesh should give concentrates satisfactorily low in silica, very low in phosphorus, and high in iron. The recovery of iron should be excellent.

Iron Mountain ore is a complex of minerals, the most important being hematite, garnet, quartz, and calcite. Due to the high specific gravity of the garnet, gravity concentration of this ore is difficult, and at best only a medium-grade concentrate can be produced. The hematite is dense, and for satisfactory magnetic roasting as a preliminary to magnetic concentration the ore must be previously crushed to a fine size or roasted at a temperature of 600° C. or more. Magnetic concentration of the roasted ore will give high recoveries and high-grade concentrates, provided that the ore treated is finer than 28 mesh.

GREAT CHEMISTS*.

In *The Chemical News*, 1929, cxxxix, 77, (August 2), an account was given of an important German publication, *Das Buch der Grossen Chemiker*, which gave an account of the lives and works of many chemists from Zosimos to Schönbein. Now there has appeared Volume II of this work under the editorship of Dr. Gunther Bugge, dealing with some thirty chemists from Liebig (born 1803) to Arrhenius (born 1859), mostly very distinguished men of science and well-known as important contributors to the development of chemistry. The title list is confined to chemists no longer living although short biographical references are made in the numerous footnotes to distinguished men, still living and whose work follows on that of the subject of the biography with which it is connected.

Most of the biographies are well done by prominent authorities, *e.g.*, Prof. Ernst Cohen has written the section on Van't Hoff and that of Ehrlich is by R. Koch, but some of the non-German biographies call for adverse comment. The lives of Lothar Meyer, Mendelejev and Ramsay are taken together, although much of Sir William Ramsay's work had no direct bearing upon the Periodic Classification of the Elements, with which subject the names of the other two are always associated. Greater importance is attached to the generalisations of Lothar Meyer which, nevertheless, are not so valuable as Mendelejev's unique and comprehensive Table. Curiously enough, Mendelejev's book on Organic Chemistry is referred to in detail, but no mention is made of his "Principles of Inorganic Chemistry," where he developed his periodic scheme and showed its utility as a basis for describing the chemical elements and their compounds. Also, reference is only briefly made to the Russian savant's many other interests and discoveries. The life and work of Sir William Ramsay has, fortunately, been described much more evenly and carefully.

The sketch of Sir William Crookes' life and work has been written by Prof. Karl Przibram of Vienna, who does not seem to have availed himself of Dr. Fournier d'Albe's able biography nor has he appar-

* *Das Buch der Grossen Chemiker.* By Dr. Gunther Bugge. Vol II. Pp. x + 559. Berlin, W.10: Verlag Chemie. 1930. Price 32 marks.

early referred for any information to Sir William's many contributions in *The Chemical News*, which he founded in 1859, and which he continued to edit until his death in 1919. The article makes mention of Lamy's independent discovery of thallium, and he needlessly casts doubt upon Crookes' priority. Again, in describing the work on the rare earths, admittedly a very difficult field, he stresses Crookes' mistake over the supposed isolation of a new element Victorium, but he does not indicate much of the valuable research work carried out by this great chemist in some of the most complex branches of inorganic chemistry.

Dr. Max Speter has written the chapter on Thomas Graham and is apparently anxious that the reader should not confuse the distinguished Scottish man of science with Silvester Graham, an American vegetarian who attained prominence around 1800 by making a bread known by his name and prepared from a mixture of cereals. One cannot well imagine any student of science confusing these two men, least of all readers of *Das Buch der Grossen Chemiker*.

It is perhaps natural that the German contributors who wrote upon their own countrymen and the development of chemistry in their country should have dealt with those subjects more effectively than with matters with which they were less familiar. Nevertheless it can be claimed that this book is an important contribution to the literature dealing with the history of science. Its value is enhanced by the extensive bibliographies (which cover Volumes I and II). These include a general list, bibliographies for individual countries—those for England (4) and America (9) are comprehensive bibliographies concerned only incidentally with science—and for each chemist. Others dealing with science, chemistry, and special branches of chemistry and references to obituary and similar notices, complete the work.

J. G. F. D.

FOREIGN TRADE IN SPAIN IN 1929.

The Department of Overseas Trade has sent us a copy of a memorandum prepared by the Commercial Secretary, H. M. Embassy at Madrid, dealing with the Foreign Trade of Spain during the year 1929. The facts and figures given are, of course, authentic and will be found both interesting and instructive, especially to all having business relations with Spain.

PROFESSOR G. ELLIOT SMITH ON THE PEKING MAN.

At University College, London, on January 15 (the Chinese Minister Presiding) Prof. G. E. Smith lectured on the Peking man. He said that the braincase found in the limestone cave at Chou Kou Tien by Mr. W. C. Pei on December 2, 1929, was the most significant and illuminating relic of primitive man ever recovered. Its characters established a bond of union between the other types of early men comparable in age, *Pithecanthropus* of Java, and *Eoanthropus* of Piltdown, which before the recent discovery seemed to be irreconcilable with one another and were both regarded with some doubt, and even by some anthropologists treated as suspect. The finding of *Sinanthropus* was not only an event of importance for the intrinsic evidence it provided, but even more so because it conferred respectability on the Ape Man of Java and the Piltdown Man. The investigations in China had established a fuller measure of confidence in these other two genera and destroyed any just grounds for the doubts regarding their nature and significance.

The evidence of the geological age of the Peking man—the early Pleistocene epoch—was more certain than that of either the Ape Man of Java or the Dawn Man of Piltdown, for the remains were found on the spot where their original owners actually left them when they died in their cave. The vast collection of animal bones, which had been carefully studied by the Chinese geologist, Mr. C. C. Young, in association with Père Teilhard de Chardin, belonged to creatures contemporaneous with the Man of Peking. They had been studied by many competent palaeontologists, who agree that they referred to an epoch more recent than the Pliocene, but definitely earlier than the loess (the Middle Pleistocene) which covered the Chili plain. It was not possible to translate this geological date with certainty into figures of years; but Professor A. W. Gabau, of the National University of Peking, claimed that the changes in the radioactive elements (studied in the way first suggested by Professor Joly, of Trinity College, Dublin) in early Pleistocene rocks suggested the possibility of a date of approximately 1,000,000 years. This, however, was to be regarded at present as little more than conjecture; it provided a general idea of the remoteness in time of the remains of *Sinanthropus*.

Whether or not the Peking Man was older than the fossils found in Java and Sussex, there was no doubt that he represented a more primitive type. His characters were more generalized, some of them distinctly reminiscent of man's simian ancestry and others strangely foreshadowing the qualities hitherto regarded as distinctive of *Homo sapiens*. In other words, *Sinanthropus* enabled us to picture the qualities of the original members of the human family by revealing a type which, though human, was curiously ape-like, and obviously close to the main line of descent of modern man.

The work of investigation and promptly reporting the results had been carried on with exceptional thoroughness, and it was hoped that the full evidence supplied to anthropologists would prevent the development of such misunderstandings as had marred the discussions of the fossil remains of man in the past. In spite of these precautions, eminent palaeontologists in Germany and France were already claiming that the Peking Man belonged to the genus *Pithecanthropus*, others in America that he was a Far Eastern example of Neanderthal Man, and others again that the Chinese fossils were not human. Having just made a careful examination of the actual remains in Peking and compared them with human and simian skulls, Dr. Elliot Smith said he could confidently support Dr. Davidson Black's claim that *Sinanthropus* was a member of the human family who revealed in every quality of his skull evidence to distinguish him from all other known human types, and to justify the separate generic rank suggested to define his status.

MARKET FOR CHEMICALS, DRUGS AND SUNDRIES IN PORTUGUESE EAST AFRICA.

A confidential report on the market for chemicals, drugs and sundries in Portuguese East Africa has been prepared by the Department of Overseas Trade from information furnished by His Majesty's Consul-General at Lourenco Marques and issued to firms whose names are entered on its Special Register.

United Kingdom firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X.6978 should be quoted.

GENERAL NOTES

FEDERATION OF BRITISH INDUSTRIES AND CANADA.

During the Imperial Conference the Federation of British Industries entered into close contact with the Dominion representatives, with the view to ascertaining what steps could be taken by industrialists to further the cause of Inter-Imperial trade. In particular several interviews took place with the Canadian Ministers attending the Conference and arrangements have now been made, with the co-operation of the Canadian Government, for a Delegation representing the Federation of British Industries to visit Canada, with a view to discussing with Canadian industrialists problems affecting the two countries. Sir James Lithgow, President of the F.B.I., will lead the Delegation.

It is proposed, in particular, to explore the possibilities of co-operation between Canadian and British industrialists, in order that co-operation may be, so far as possible, substituted for competition between the industries of the two countries.

The Federation of British Industries recognise that it is the legitimate desire of Canadian industry to supply, so far as possible, Canadian requirements. They fully accept this view, and are prepared to co-operate in any way desirable and possible in the development of industry in Canada. On the other hand, they believe that it is the desire of Canadians, in so far as they have to satisfy their wants from outside sources, to encourage imports from Great Britain rather than from foreign sources. The various problems involved will need careful discussion, but there is no doubt that, with the goodwill which exists on both sides, substantial progress should be possible towards a rationalisation of production between the two countries.

The Federation of British Industries were gravely concerned at the failure of the Imperial Conference to make any sensible progress towards improving the trade relations of the Empire, and they welcome the opportunity of sending a Delegation to Canada in order to prove that the industrialists at least of Great Britain are sincere in their desire to foster Inter-Imperial trade.

MERCHANDISE MARKS ACT, 1926.

Board of Trade Announcement.

The Board of Trade announce that in pursuance of Section 7 of the Merchandise Marks Act, 1926, a draft Order in Council was laid before Parliament on the 21 January, requiring fertilisers and feeding stuffs of the following descriptions :—

(a) Bone meal and bone flour whether raw degreased or degelatinised;
(b) Hoof meal, horn meal and mixtures thereof;
(c) Meat meal, meat and bone meal and carcase meal;
(d) Dried blood, whether ground or unground;

to bear an indication of origin on importation into, and on sale or exposure for sale in, the United Kingdom.

BRITAIN'S INCREASED TRADE WITH SPAIN.

The growing importance of trade between Spain and England is emphasised in a report prepared by the Commercial Secretary to the British Embassy at Madrid, and which has just been published.

The report reviews trade in Spain during 1929, the complete figures just being available. Great Britain's exports to Spain increased so much that she displaced France, and took second place instead of third in the list of countries supplying goods to Spain. In view of the greater transport advantages which France enjoys over England, this was a notable feat.

Both the United States and France sup*plied less produce and goods to Spain during* the year and the lead of the United States over this country was reduced from £8,052,000 to £3,168,000.

This challenge to American supremacy is accounted for by the increased export of certain British commodities which previously were negligible.

Many of these commodities are produced by British manufacturers who have been interested in Spain's recent development schemes. For example, Great Britain became the chief supplier of tar for Spain's new arterial highways, and electric cables for her great hydro-electric schemes. Another satisfactory development is the commanding place occupied by Great Britain in the aeroplane trade. Of forty aeroplanes and seaplanes imported into Spain during 1929 Great Britain supplied twenty-nine, Germany seven, France three, and Holland one.

1931 AWARDS BY THE GEOLOGICAL SOCIETY OF LONDON.

The following awards have been made by the Council of the above Society.

The Wollaston Medal to Dr. Austin Williams Rogers, of the Geological Survey of the Union of South Africa, in recognition of the value of his work on the geology of South Africa.

The Murchison Medal to Dr. George Walter Tyrrell, of the University of Glasgow, for his work on the igneous rocks of the West of Scotland.

The Lyell Medal to Ernest Clayton Andrews, *of the Geological* Survey of New South Wales, for his researches on the economic geology of New South Wales and on physical geology.

The Bigsby Medal to Dr. Norman L. Bowen, of the Geological Laboratory, Carnegie Institution, Washington, D.C., in recognition of the value of his researches on the physical chemistry of igneous rocks.

The Wollaston Fund to Dr. Robert G. S. Hudson, for his work on the stratigraphy and palaeontology of the carboniferous rocks of Yorkshire.

The Murchison Fund to Dr. Cyril James Stubblefield, for his researches on the Cambrian rocks of Shropshire, and on invertebrate palaeontology.

A moiety of the Lyell Fund to Dr. Oliver M. B. Bulman, in recognition of his work on the Cambrian rocks of Shropshire, and of his palaeontological researches.

A second moiety of the Lyell Fund to Mr. William Howson Wilcockson, for his work on petrology and economic geology.

IMPERIAL CHEMICAL INDUSTRIES INSTRUCTIVE EXHIBIT.

No stand at the forthcoming British Industries Fair, at Olympia, London, will be more eloquently descriptive of the worldwide character of British trade than that by Imperial Chemical Industries.

This will be found in the Main Hall at Olympia, and will be a lesson in geography, and especially in the geography of the British Empire. It will take the form of a modern building on which are placed in alcoves bold cut-out maps of the six continents—Europe, Asia, Africa, North and South America, and Australia and New Zealand. Around each map will be grouped

samples of I.C.I. products relating to the trade of the continent concerned, together with examples of the products of each continent in which articles of I.C.I. manufacture are used. Further, each map will show the centres all over the world where the associated companies of I.C.I. have fateories and direct representation. This arrangement will make a special appeal to the overseas visitor, because no matter from what part of the world he may come, he will find some article of interest linked to the information of how and where to buy it near his home.

The stand will also act as a guide to the Fair for on it is a large scale of Olympia, showing all the various industries represented, and how each is a customer or consumer of I.C.I. products.

The stand will, therefore, be an epitome of the objects which the British Industries Fair is designed to promote. It aims definitely at attracting and holding the interest of the buyer from overseas.

It is also an extraordinary object lesson of the ubiquity of the chemical industry and of its essential nature to Industry and Agriculture the world over. It will be interesting alike to the trade visitor or to the schoolboy.

Within the stand there will be a practically continuous cinematograph performance of films made to illustrate the manufacture of many I.C.I. products, from pictures of general interest such as the clay pigeon film "Gunning Without Game," to those of a more technical nature.

THE NEW SERVICE LABORATORY FOR THE RUBBER INDUSTRY.

The Rubber Service Laboratory just rebuilt and more fully equipped in connection with the Dyes Group of Imperial Chemical Industries Limited at Blackley, Manchester, was opened on Thursday, January 22, 1931.

Work has actually been going on for some time in this the latest addition to the Service Laboratories of the Dyes Group of Imperial Chemical Industries, which have been supplying for many years information on the application of dyestuffs. In consequence, users have made certain of obtaining satisfaction in the results obtained in use.

Organic Rubber chemicals are very closely allied in constitution to organic dyestuffs and the work of research has to a large extent proceeded along paralle lines in what it is believed are the finest industrial research laboratories in the country.

In the same way, the application of rubber chemicals was given consideration several years ago and a Rubber Service Laboratory was established.

During the time that it has been functioning, this has proved itself to be of very great value and the large and rapid increase both in the number of technical enquiries and in sales of Vulcafor products are evidence of success.

With the object of making the work undertaken even more useful than before, new Rubber Service Laboratories have recently been put into operation. They are equipped with the latest types of rubber processing and testing machinery. The Machinery itself is described later.

The senior staff of the Laboratories are all university graduates and in the selection of the staff care has been taken to include men with practical experience in the rubber and allied industries, thus ensuring complete understanding of the problems presented for consideration.

THE WORK OF THE I.C.I. RUBBER SERVICE LABORATORIES.

The work carried out in the Laboratories can be classified mainly under three headings :—

1. RUBBER SERVICE FOR USERS OF VULCAFOR PRODUCTS.

The Laboratories are always prepared to render assistance in the solution of problems which arise in connection with the use of accelerators, anti-agers, colours and other products.

2. ROUTINE TESTING OF VULCAFOR PRODUCTS :

Vulcafor Products are tested by the Analytical Laboratory to see that they conform with stringent chemical and physical specifications, and are then submitted to actual vulcanisation tests in the Rubber Service Laboratories. The Company takes pride in the consistent quality of its products, and each delivery of an accelerator or colour is thus checked before despatch.

The strength and shade of all colours are tested by compounding and curing under standard conditions.

Under this heading of Routine Testing, should be included the constant examination and comparison of competitive products from all over the world; it is in this

way that British Rubber Manufacturers can be assured of a range of products equal to or better than any available to his foreign competitors.

3. RESEARCH WORK :

Research work represents one of the most important activities of the Rubber Service Department. This work may be divided into three classes :

(a) a constant study of organic compounds with a view to developing new and more useful products for use in the rubber trade.

(b) research dealing with the properties of various rubber compounds and the development of improved methods of physical and chemical testing.

(c) industrial research connected with the development of new or improved manufacturing processes.

As a result of this work in the past, a vast number of patents have been taken out throughout the world for new products and processes for use in the rubber industry.

The laboratories contain plant for mixing and processing including calendering, extruding, spreading and curing. There are in addition physical testing machines of various types, dumb-bell and ring, abrasion testing, and flexing equipment, etc. Accelerated "ageing" is studied by the standard methods such as Geer Ovens, oxygen bombs, ozone and ultro-violet light.

Lastly, it should be kept in view that Rubber Service Laboratories are not an isolated unit, but work in close collaboration with the Research Laboratories which are believed to be the best industrial chemical research laboratories in the United Kingdom. This means that the various problems which may arise in connection with rubber service work, and which require examination in the Analytical, Optical or Electrical Laboratories, can be dealt with by experts in these particular fields. The optical and electrical laboratories are equipped with the latest equipment and can deal at very short notice, with such problems as break-down voltages or resistivity. It is for this reason only, that the new Rubber Service Laboratories have not been equipped with the usual analytical and optical laboratories often associated with such laboratories.

MARKET FOR DISINFECTANTS, INSECTICIDES AND ANIMAL DRESSINGS IN THE REPUBLIC OF GUATEMALA.

A confidential report on the market for disinfectants, insecticides and animal dressings in the Republic of Guatemala has been prepared by the Department of Overseas Trade from information furnished by the British Vice-Consul at Guatemala and issued to firms whose names are entered on its Special Register.

United Kingdom firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X.6971 should be quoted.

UNITED KINGDOM TRADE MISSION TO EGYPT.

A FLOATING "TRADE OFFICE."

All connected with the British Trade Mission to Egypt, particulars of which were announced to the press on the 16 December, are working at top pressure, completing their preparations in order to arrive in Egypt early in February—which means leaving at the end of the present month.

This involves an enormous activity in meeting representative bodies of industry, trade and shipping in this country, discussing with them the possibility of a British trade push in Egypt.

There is, of course, a good deal of spade work which has to be done in the normal course, before a Mission leaves, but the time at the disposal of the members of the Mission, Sir Arthur Balfour, Sir Alan Anderson, Mr. W. R. Blair and Mr. Kenneth Lee is so limited, that the work of classifying data, etc., will have to be done on the voyage out. The ship will become a veritable floating "trade office."

Immediately upon arrival in Egypt the Mission will get down to brass tacks, and as soon as it had paid the customary respects to the Egyptian Goverment it will commence the real business of getting into touch with the heads of Egyptian Government Departments, and in reviewing the trade situation with British and Egyptian merchants and representative bodies in Cairo and Alexandria with a special view to ascertaining how best to push British goods in Egypt.

The experience gained by the previous Missions which have gone out under the auspices of the Department of Overseas Trade will undoubtedly prove of invaluable help, as all aspects of British trade will be examined in the light of the fresh experience gained, and a determined effort will be made to improve in every respect commercial relations between this country and Egypt to mutual advantage.

Whilst in Egypt the Mission will be assisted by the Commercial Secretary to the Residency, Cairo, Mr. R. M. Turner, O.B.E., while the local British Chamber of Commerce will place its organisation at the disposal of the Mission.

The Mission goes out at a psychological moment, in view of the fact that the purchasing power of the Egyptian public is understood to be increasing with the march of progress in that country. The moment will therefore appear propitious for a larger share for Britain in Egypt's foreign trade.

The Mission is expected to arrive at Port Said on the 11 February, and will leave Egypt on or about the 8 March, and no time will be lost in the preparation of its report on its return to England.

GAS ENGINEERS TO CONSIDER STREET-LIGHTING.

The Institution of Gas Engineers has appointed a special committee to enquire into the subject of street illumination, in view of the increasing number of street accidents which occur at night.

Announcing this decision, the "Gas Journal," the official organ of the industry, considers that the development of the street-lighting load was the most satisfactory feature of the year.

"The installation of centrally-suspended gas-lamps in the Borough of Lewisham," states the current issue of the Journal, "is of great interest and importance, for it led to the reorganisation of the gas lighting in many important centres both in London and the Provinces. The conditions at Lewisham are essentially modern, with swift-moving traffic of great volume, and it has been shown that gas is better able than electricity to meet them.

"Local authorities want a reliable light; work in 1930 has demonstrated that they have it in gas. Motorists need an illuminant which has the greatest power of penetration, which is diffuse, and which is free from glare; they have these qualities in gas. And the pedestrian cries for greater safety, which means more and better light at the lowest cost; these requirements, too, are met by gas.

WORLD DEPRESSION.

Reviewing the condition of Canadian activities last year the Royal Bank of Canada incidentally refers to the worldwide depression which has prevailed for sometime. There are, it says, few industries which have not been seriously affected by the prevailing depression. The fall in the general price level has restricted the movements of international trade; internal trade has been stagnant and unemployment has become general in many countries. The decline in the price of farm products has been particularly severe, with the consequence that there are few countries where farm purchasing power has not been seriously reduced. During 1928 and 1929, stock market profits permitted consumers to spend abnormal amounts; a recession from the high levels then attained was inevitable. The abnormal credit conditions which were produced by this excessive speculation upset international trade relationships and the subsequent fall in commodity prices produced chaotic financial and political conditions which must be corrected before world trade can be re-established on a normal basis.

Against the background of this worldwide depression, conditions in Canada seem relatively favourable. The reduction in the purchasing power of many of the countries which buy Canadian products has been reflected in our exports. The aggregate value of Canadian foreign trade has declined approximately 22 per cent. During the twelve months ending October 31, exports amounted to $946,000,000 against $1,281,000,000 in the previous year. The imports in 1930 were $1,065,000,000 and in 1929 $1,303,000,000.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

At the meeting of the American Association, held at Cleveland, Ohio, many startling suggestions were put forward. It was prophesied, for instance, that there would be a universal language and a world population of 35,000,000,000 in the year 2500.

(The world's present population is estimated at nearly 2,000,000,000.)

A warning that our present culture was heading for a terrible crash unless scientists united to forestall it, was given by Professor A. V. Kidder, an archæologist, of the Carnegie Institute of Washington.

Prof. W. W. Ogburn, a sociologist, of Chicago University, and Prof. E. M. East, a biologist, of Harvard University, predicted that by the time the world has reached 2500 the whites will be in full possession of the Americas and of Africa, and the native population will have largely disappeared.

Asia will be held solidly by the Mongolians.

Through increased efficiency and the application of scientific methods in farming only a fraction of the people will be needed on the farm, and the rest will have to be absorbed into industry.

Better use will be made of farm produce, and the factory will be right on the farm. The less valuable land will revert to forest.

Coal and oil will be nearly exhausted.

LONG SERVICE AWARDS TO 1,300 EMPLOYEES.

Certificates for 33,750 Years' Work for Company.

Long Service Certificates representing 33,750 years' unbroken employment are this week being presented to Co-partner employees of the South Metropolitan Gas Company.

Over thirteen hundred workers who have completed twenty-five years' service with the Company in the production of South London's gas supply are receiving these official certificates which have been personally autographed by the President, Dr. Charles Carpenter in recognition of their faithful service.

Each certificate is beautifully illuminated with scenes of old London, the arms of the South Metropolitan Gas Company and the crests of the ten boroughs in which the company operates.

RESEARCH FELLOWSHIPS IN METALLURGY AND MINING AT THE UNIVERSITY OF MISSOURI SCHOOL OF MINES AND METALLURGY.

In co-operation with the United States Bureau of Mines and the State Mining Experiment Station, the School of Mines and Metallurgy of the University of Missouri offers four fellowships. These fellowships are open to graduates who have the equivalent of a Bachelor of Science degree and have had the proper training in mining, metallurgy, or chemistry, and who are qualified to undertake research work. The income of each fellowship is $800 for ten months beginning September 1, 1931. Fellows pay fees amounting to approximately $44 per year.

Fellows will register as students in the School of Mines and Metallurgy of the University of Missouri, and become candidates for the degree of Master of Science (unless this or an equivalent degree has been earned). Their class work will be directed by the heads of the departments of instruction of the Bureau of Mines staff resident at the School of Mines. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of the State of Missouri. For 1931-32 the four fellowships will be granted in the following subjects :

Ore Dressing : Problems in Concentration, including Grinding, Jigging, Classifying, Tabling, Flotation of Sulphides and Non-sulphide Ores and Magnetic Concentration; Dissection of Ores by Elutriation, Heavy Liquids, and Microscopic Study by Petrographic and Mineragraphic Methods.

Applications, with a certified copy of collegiate record, statement of professional experience, and names and addresses of three references will be received up to June 15, 1931. In the case of applications from foreign countries, it is essential that the applicant be familiar with the reading, writing, and speaking knowledge of the English language.

The Application should be addressed :—
Director, School of Mines and Metallurgy, University of Missouri, Rolla, Missouri.

MINING ACTIVITY IN NORTH-WEST TERRITORIES.

During the past season exploration for minerals and investigations of discoveries in the North-west Territories were continued actively. The results may be summarized as reasonably successful. Discoveries have been chiefly of base metals --copper, lead-zinc, and nickel—but in the mineralised areas too little work has yet been done to determine their possibilities. The occurrence of cobalt and uranium at the southeasterly side of Great Bear Lake, is somewhat similar to the cobalt area of northern Ontario, and suggests silver possibilities. The apparently extensive copper deposits of the Coppermine area resemble the Michigan deposits in mode of occurrence and geological situation, and point to this district as one of the big copper reserves of the future, while the development work of the season has demonstrated new possibilities in the lead-zinc deposits of Great Slave Lake.

There were three principal areas of interest. On the east the Cyril Knight Prospecting Company continued their investigation of their pyrrhotite find on Rankin inlet, on the west coast of Hudson Bay. A diamond drill was brought in to prove the thickness and character of the mineralisation, and to determine its dip and value at greater depths.

In the south, active work was carried on in the lead-zinc area south of Pine point on Great Slave Lake. A systematic study of the deposits is being made by careful surface investigation and by drilling. Dominion explorers examined a silver-lead discovery on the upper reaches of the South Nahanni river. Ore of possible commercial value was found, but in a situation difficult of access. Drilling for oil in the vicinity of the mouth of Hay river, which was started in 1929 and abandoned, was resumed this year.

The chief northern field of interest was in the country between Great Bear Lake and the Arctic coast. A rich discovery of copper sulphides was staked in 1929 at the easterly extremity of McTavish Bay. This attracted interest during the past season. Dominion Explorers became interested in this find and brought in men and materials by aeroplane during the spring. LaBine Brothers moved into the same area, and Consolidated Mining and Smelting Limited also established a base there. During the season, fairly intensive prospecting was carried on and a number of claims were staked by the various companies. The copper ores appear to be both rich and abundant. A discovery of pitch-blende was made in the same general locality that has considerable interest as a possible source of radium. Associated with it are cobalt, bismuth, and other minerals. North-east from Great Bear lake the Coppermine formation occupies a wide area, extending to the Arctic coast and islands. Northern Aerial Minerals Exploration Company Limited, covered a large part of this area with aerial observations, and in detail on the ground at many points. Their prospectors found the formation generally mineralized, but lacking in commercial concentration except in certain situations. Six discoveries were made in the western portion of the area. These are all copper sulphides, and one in particular is very promising. Both Northern Aerial Minerals Exploration and Dominion Explorers staked claims in this district. As early as 1820 an occurrence of galena was noted on the Arctic coast near Detention harbour. During the past season claims were staked in the vicinity of Galena point as it is called, where it is reported rich, silver-bearing galena has been found. A find of Iceland spar, near the Arctic coast to the west of Mackenzie river was investigated by the Dominion Explorers.

Results have given the needed encouragement to the exploration companies which have been carrying on operations in the Northwest Territories during the last three years, and support the optimism of those who have looked to the minerals of the North to assist in its development. The Supervisory Mining Engineer's Branch of the Department of the Interior has established an Office at Fort Smith, in the North-west Territories and field parties have followed the mineral investigations in the various districts in order to keep the Department in touch with the situation, and to enable it to assist with the problems of development as they arise.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, January 22.

The following papers were read :—

The Development of a High Speed Wind Channel for Research in External Ballistics. By SIR THOMAS STANTON, F.R.S.

The Scattering of Slow α-Particles in Helium. By P. M. S. BLACKETT AND F. C. CHAMPION. Communicated by Lord Rutherford, F.R.S.

Mott has calculated the scattering of α particles by helium atoms on the assumption that the particles interact according to the *inverse square law*, that they have no nuclear spin, and that they obey the Einstein-Bose statistics. It is found that *the scattering should vary periodically with* changing angle and velocity, in fact, an interference pattern should be obtained whose scale depends on the velocity. This theory has been tested by photographing the collisions between slow α particles and helium atoms in a Wilson Chamber. The results are in complete agreement with Mott's theory.

The Yield Point and Initial Stages of Plastic Strain in Mild Steel. By G. COOK. Communicated by E. V. Appleton, F.R.S.

The following papers were read in title only :—

Explosions of Mixtures of Acetylene and Electrolytic Gas. By W. A. BONE, F.R.S., R. P. FRASER AND F. LAKE.

The paper deals fully with the disturbing influence of successive additions of acetylene upon the uniformity of the initial flame movement in an explosion of electrolytic gas. Such influence attains a maximum when 20 per cent. of acetylene is present in the medium, thereafter declining, and eventually disappearing when 30 per cent. of acetylene is present. From photographic and chemical analyses, combined with flame speed measurements, etc., the course of the phenomenon is shown to be a primary selective partial combustion of acetylene, $C_2H_2+O_2=CO+H_2$, in the flame front (except where only very small proportions of it are present), followed, behind the flame front, by either (i) when sufficient oxygen is present, a highly luminous combustion of the nascent CO or (ii) otherwise, by a thermal decomposition of any unburnt acetylene. No carbon is liberated until the acetylene exceeds the $C_2H_2+O_2+2H_2$ proportion, at which point the flame is thinnest and the combustion is in exact accordance with the equation $C_2H_2+O_2+2H_2=2CO+3H_2$. It is also shown that the explosion of a $C_2H_2+O_2+2H_2$ mixture is differently affected by an equal dilution with argon or nitrogen, or that while argon acts as an inert diluent nitrogen does not.

Flame Speeds in the Inflammation and Detonation of CO-O_2 *Mixtures.* By W. A. BONE, F.R.S., AND R. P. FRAZER.

It is shown experimentally that both in the initial phase of "inflammation," and in the final stage of "detonation," the maximum flame speed for moist carbonic oxide-oxygen mixtures at atmospheric pressure is obtained with a *circa* $3CO+O_2$, instead of a theoretical $2CO+O_2$, mixture. Also, it is shown that dilution of the medium with either argon, helium or nitrogen does not materially alter the proportions of carbonic oxide and oxygen in the maximum-speed mixture.

Such results can hardly mean other than that with moist carbonic oxide-oxygen mixtures the point of maximum flame speed is principally determined neither by the density of the medium, nor by flame temperature, nor by suppression of CO_2-dissociation nor the like, but rather by the CO-concentration itself. And such a conclusion points to the combustion of moist carbonic oxide being conditioned by a prior "excitation" of its molecules which are then, but not otherwise, rendered combustible.

The Isotropic Constitution and Atomic Weights of Zinc, Chromium and Molybdenum. By F. W. ASTON, F.R.S.

The Ternary System of Carbon Monoxide-Nitrogen - Hydrogen. By T. T. H. VERSCHOYLE. Communicated by F. A. Freeth, F.R.S.

The Spectrum of Singly Ionised Antimony. By D. G. DHAVALE. Communicated by M. N. Saha, F.R.S.

Interferometric Measurements in the Arc Spectrum of Iron. By C. V. JACKSON. Communicated by A. Fowler, F.R.S.

Ten lines in the spectrum of the iron arc in air, between λ 4,000 and λ 4,400, have been measured by interferometric comparison with the red line of cadmium or with the secondary standards of neon. The results are found to be in almost perfect agreement with the wave-lengths recommended by the International Astronomical Union in 1928, the mean systematic difference (J-I.A) being only +0.0003 A, while the mean accidental difference is $\pm$ 0.0006 A

Sixty-eight lines in the spectrum of the iron arc in air between λ 2,300 and λ 3,100, have also been measured interferometrically. These agree well with the vacuum arc measurements of Burns and Walters, but, as is to be expected, on account of the pressure shift they are slightly greater in wave-length, the mean systematic difference being 0.0003 A, while the mean accidental difference is $\pm$0.001 A. The agreement with the computed values for the arc in air given by the I.A.U. is equally satisfactory, and that with certain wave-lengths calcu-

lated by the author from energy levels given by Babcock, is also very satisfactory. The measurements above λ 2,800 agree very well with Burn's interpolated values of 1913 when the latter are corrected by means of the table given recently by Burns.

Five lines of mercury in the ultraviolet have also been measured.

INSTITUTE OF METALS.

A New Monthly Journal.

At the Annual General Meeting of the Institute of Metals, to be held on March 11-12 in London, fourteen papers—covering a wide field of metallurgical work—will be presented for discussion. In the evening of March 11 the Annual Dinner and Dance of the Institute will be held at the Trocadero Restaurant.

The Institute has just issued the first number—dated January, 1931—of its new monthly *Journal*, containing original articles, Institute news, and several hundreds of abstracts of all the world's metallurgical literature—96 pages in all. Hitherto the *Journal* has appeared in the form of half-yearly volumes divided into two Sections: " Proceedings " and " Abstracts." Henceforward the volumes issued each June and December will contain only " Proceedings," and the " 'Abstracts " will appear monthly—to be re-issued in volume form at the end of each year. The effect of this arrangement is to speed up the receipt of the abstracts—which can be used for card indexing purposes—by several months; furthermore, it will make the half-yearly volumes, which had grown rather bulky, easier to handle. It is anticipated by the Council that the new method of monthly publication will appeal particularly to research workers and to those engaged in industry, as it will enable them to keep in very close touch with the latest metallurgical developments throughout the world. A large increase in the Institute's membership will, it is expected, result from the new facilities thus made available.

The next election of Members is on February 20, and persons then elected have the privilege of Membership, not for the usual twelve months, but for the extended period ending June 30, 1932. The Secretary of the Institute is Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1., and from him Membership application forms and full details of the Institute's many activities may be obtained.

CORRESPONDENCE.

THE POWER OF VEGETABLE LIFE.

(*To the Editor of* The Chemical News.)

Sir,—Apropos of Loring and Druce's great attempt to make living plants responsible for a matter concerning the isotopes of potassium, may I remind you of the two following paragraphs taken from *The Chemical News*, 1925, cxxxi, 145, and 1926, cxxxii, 165, in which the power of vegetable life was suspected of being the means of creation of two chemical elements, iodine and zinc :

" The evidence of mineralogy is that the ultimate matrix of Zn is a zinciferous clay, such as occurs at Friedensville in considerable abundance with calamite, an oxide of Zn and Si. Seamon (Dana) says that the calamine has been gradually crystallised out of the zinciferous clays, *these having been first formed.* The inference that is made here is that the clay became zinciferous because the element Zn was first created by some means in or on this clay. Apropos of this, zinc is found in the ashes of the yellow pansy growing in Rhenish Prussia in soil which contains that element. This has been recorded as an especially noticeable fact, and since it exactly represents a state of affairs that was suspected of being the cause of a soil becoming zinciferous, it is inferred not that the plant happens to be growing luxuriantly in this position because it found zinc there, but that the power of vegetable life has atomised the KCN in the plant and thus produced in the soil a deposit of zinc, the accumulation of ages."

" The ultimate matrix of iodine has been traced to sea-weed, in which the element has been and is being formed by the Power of Vegetable Life. The sea-weed is surrounded by a solution of NaCl. the very substance required for the formation of iodine; and $4NaCl = Na_4Cl.Cl_3 = ICl_3$. The last, a well-known compouud, is the first molecule containing iodine to be formed."

Yours very truly,

Hawksworth Collins.

NOTICES OF BOOKS.

The British Journal Photographic Almanac, 1931. Edited by George E. Brown, F.I.C. Pp. 748 + 64 pages of photogravure supplements. London : Henry Greenwood & Co., Ltd., 24, Wellington Street. Price 2s. net (paper covers); 3s. net (cloth bound).

The 1931 issue of the *British Journal of Photography's Photographic Almanac* fully

maintains the high standard of its many predecessors. It opens with an important article by the Editor, Mr. G. E. Brown, F.I.C., entitled, " Makers of Photography," in which he gives a lucid and concise history of photography. The reviewer is of opinion that this account is the most reliable and evenly balanced history of the development of the subject for, whilst the German *Geschichte* by Eder is more comprehensive and Potonniée's *Histoire* deals with the subject from the French standpoint, the contribution in the 1931 *Almanac* carefully denotes the actual contributions and influence of the outstanding personalities who have contributed to the advancement of photographic science.

Another important feature of the *Almanac* is the " Epitome of Progress." This extends to nearly 60 pages and includes all the results of recent research and new devices in connection with the many processes from improved apparatus to new methods in the production of ciné films.

Besides the Tables of photographic data and constants, formulæ and other miscellaneous information there are articles on " Modern Enlarging " by T. L. J. Bentley, B.Sc., " A Note on Bromoil," by L. H. Sharpe, B.Sc., " Colour Photography," by Capt. O. Wheeler, and three obituary notices. The volume contains so much valuable information that it has become indispensable to all who claim to use a camera intelligently.

J. G. F. D.

The Chemistry of Some Common Substances. By C. H. DOBINSON, B.A., B.Sc. Pp. 64. London : A. & C. Black, Ltd., 4-6, Soho Square, W. 1931. Price 1s. 6d.

The object of this book, which is No. 4 of Black's *Elementary Science Note-Books*, is to provide an easy course of chemical experiments which can be performed with the simplest apparatus. The treatment is arranged to afford a training in scientific method and accurate observation. The Note-Book contains blank ruled lines where the pupil can record his own observations and results and answer questions which will assist him in forming the correct conclusion from his work. Whilst all the actual experiments can be described as simple and elementary, many of them lead up to an appreciation of the chemistry of everyday domestic and industrial life and this attempt to indicate the wider issues following upon scientific experiment is very commendable. [illegible] with clear line diagrams and photographs including good photomicrographs) and deserves the careful attention and consideration of all science masters.

The three other of Black's *Elementary Science Note-Books*, edited by G. N. Pengriff, M.A., B.Sc., are (1) Physical Measurements and Elementary Mechanics; (2) Everyday Physics and Heat; and (3) Plant Growth, and the Soil in Relation to Foodstuffs.

A NEW RUSSIAN PUBLICATION.

The Leningrad Academy of Sciences has just issued No. 1 of a new publication called " The Works of the Laboratory for Bio-Geo-Chemistry." In the Foreword it is explained that it will be devoted to a study of the movements of the elements through the biosphere under the influence of living matter. The facts will be collected, examined, classified and generalisations based upon them will be put forward. The first number includes the following contributions —V. Vernadsky : General Considerations on the Study of the Composition of Living Matter (in French); A. Vinogradov : Chemical Composition of Plankton from Detské Sélo; A. Lebediancev : Geochemical Constants of Certain Agricultural Plants; E. Cholodovsky : Calculation of the Multiplication of Organisms (in French); B. Brunovsky : The Concentration of Radioactivity in Living Organisms.

Most of the articles are in Russian so that although they are all important and of general interest they may not receive adequate attention among men of science in Western countries.

Forthcoming Events.

ROYAL INSTITUTION.
21, Albemarle Street, W.1.

Monday, February 2, at 5 p.m.—General Meeting.

Tuesday, February 3, at 5.15 p.m.— " Art of Illumination." By F. W. T. Walsh.

Thursday, February 5, at 5.15 p.m.— " Nature of Physical Science." By Herbert Dingle.

Friday, February 6, at 9 p.m.— " Mechanics of the Trade Slump." By F. M. Keynes.

ROYAL SOCIETY OF ARTS.
John Street, Adelphi, London, W.C.2.

Monday, February 2, at 8 p.m.—(Cantor

Lecture).—" Some Modern Developments in Microscopy." Lecture II. By L. C. Martin, D.Sc., A.R.C.S., D.I.C.

Wednesday, February 4th, at 8 p.m.—(Ordinary Meeting.) " The Effect of Standardisation on Engineering Progress." By C. Le Maistre, C.B.E.

THE PHYSICAL SOCIETY.

Friday, February 6, at the Imperial College of Science, Imperial Institute Road, South Kensington, at 5 p.m.—Ordinary Meeting.

MANCHESTER CHEMICAL SOCIETIES.

Institute of Chemistry.

Thursday, February 5, at 7 p.m., in the Manchester, Ltd., Royal Exchange.—Prof. F. L. Pyman, Ph.D., F.I.C., F.R.S.

Oil and Colour Chemists' Association.

Friday, February 6, at 7 p.m., at Milton Hall, Deansgate—Members' Evening.

Friday, February 6, at 7 p.m., at Engineers' Club, Manchester.

(I) " Plant Used in the Manufacture of Synthetic Resins." By A. Fraser.

(II) " Synthetic Resins." By Dr. E. E. Walker and E. A. Bevan.

INSTITUTE OF METALS.

Birmingham Local Section.

Tuesday, February 3, at 7 p.m., in the Chamber of Commerce, New Street, Birmingham.—Discussion on " Refractories." To be opened by C. E. Moore and I. A. Bailey.

SOCIETY OF PUBLIC ANALYSTS.

Wednesday, February 4, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1., at 8 p.m. :—

" Some Factors Affecting the Solubility of Milk Powder." By L. H. Lampitt, D.Sc., F.I.C., and J. H. Bushill, M.Sc., A.I.C.

(i) " The Determination of the Hydroxyl Content of Organic Compounds : Estimation of Castol Oil."

(ii) " The Determination of the Carbonyl and Aldehyde Content of Organic Compounds : Estimation of Phenylhydrazine." By S. Marks, M.Sc., A.I.C., and R. S. Morrell, Ph.D., F.I.C.

" Food Control in Holland." By A. van Raalte, D.Sc., and J. Straub (Director and Assistant Director of the Amsterdam Food Inspection Service).

" The Determination of Small Quantities of Methane." By H. R. Ambler, M.Sc., F.I.C.

"The Fatty Acids and Component Glycerides of Indian Ghee." By R. Bhattacharya, and T. P. Hilditch, D.Sc., F.I.C.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

367.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of alkyl ethers of aminobeta - hydroxyanthraquinones. January 5.

750.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of sulphurised phenols. January 8.

751.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of aromatic monaroyldiamines. January 8.

Specifications Published.

340,524.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture and production of vat dyestuffs of the 1 : 2-benzanthraquinone series.

340,509.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of anthraquinone and homologues of the same.

340,639.—I. G. Farbenindustrie Akt.-Ges. Manufacture of a-hydroxy-anthrones.

340,682.—Schering-Kahlbaum Akt.-Ges. — Process for the manufacture of alkylated phenols.

Abstract Published.

338,566.—Nitric Acid. — Caro, N., 97, Hohenzollerdamm, Dahlen, and Frank, A. R., 138, Kurfurstendamm, Halensee, both in Berlin.

Nitric acid is prepared by the combustion of ammonia with oxygen or gases containing oxygen under normal pressure, the resulting nitrogen oxides being compressed, after leaving the combustion elements, to a pressure of several atmospheres in a turbo compressor and converted under this pres-

sure into nitric acid by condensation and absorption. The gases may be cooled before compression to separate excess of water. The gases remaining after absorption are allowed to expand in an expansion turbine coupled with the turbo-compressor. Specifications 311,553 and 311,934 are referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

PERCHLORON.

514,548.—Chemical substances containing hypochlorite used in manufactures, photography or philosophical research.—I. G. Farbenindustrie Aktiengesellschaft, 28, Mainzer Landstrasse, Frankfurt - on - the - Main, Germany. January 14th. (Associated.)

517,949.—Chemical substances used for agricultural and horticultural purposes.—Genzyme, Ltd., Barking Guano Works, Barking, Essex. January 14. (Associated.)

GENZYMIC.

517,950.—Chemical substances used for agricultural and horticultural purposes.—Genzyme, Ltd., Barking Guano Works, Barking, Essex. January 14. (Associated.)

CEBEX.

515,864.—All goods in class 1 which includes chemical substances used in manufactures, photography or philosophical research.—Chemical Building Products, Ltd., Albion House, 59, New Oxford Street, London, W.C.1. January 14. (Associated.)

POLNIC.

518,043.—All goods in class 2 which includes chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Cooper McDougall and Robertson, Ltd., Chemical Works, Ravens Lane, Berkhamsted, Hertfordshire. January 7. (Associated).

GRAMMAR OF LOGIC.

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BOOKS FOR SALE.

There are many books of Scientific and Historical importance for sale at the Chemical News Office at reasonable prices. List and Prices will be sent on application to the Manager, Chemical News, Merton House, Salisbury Square London, E.C.4.

THE INFLUENCE OF PHYSICAL RESEARCH ON THE DEVELOPMENT OF WIRELESS.

By W. H. ECCLES, D.Sc., F.R.S., F.Inst.P.

(*Presidential Address given before the Institute of Physics.*)

The Institute of Physics was incorporated in 1920 as a result of the recognition won by trained physicists exercising their knowledge in the war, and in anticipation of their future usefulness in British industry. Before the war a few physicists had penetrated into industries such as that of instrument making, and others had passed into electrical and other branches of engineering; but they had not been systematically enlisted in large numbers in any industry for the sake of their knowledge of physics. During the war, however, the services of the physicist as a specialist were found useful in the field and in the factories. To-day the meaning of the word, and the potentialities of the professional physicist, have been grasped by the State and by the more acute leaders in the industries—though in some instances the physicist still creeps into factories in the guise of an engineer.

The first ten years of the Institute's existence have shown that its inauguration was justifiable. Though not a large Institute it has attained stability. The qualifications for corporate membership are severe; they comprise both theoretical learning and research experience, otherwise the membership would be larger. But taking the membership as it stands, I feel we may regard it as an encouraging indication of the advance this country has made during the past twelve years in the direct applications of physics to industry. Nevertheless, there are still many who remain unconvinced of the profitableness of physical research laboratories. In selecting my matter I have to pass over many engineering achievements that stand out as remarkable, not only in the history of radio communications but also in the wider chronicle of electrical and general engineering. The work of the engineers, has, however, been written up already.

I will limit myself almost entirely to the influence of physical research after wireless began. When did it begin? That is a matter of definition. We might, if we chose, date it from Hughes, or from Crookes' definite suggestion in 1892 that Hertzian waves would some day be used for telegraphy, or from Henry Jackson's

contemporary suggestions for naval signalling, or from the date of transmission of the first complete message. But from the physicists' point of view wireless telegraphy may have said to have been achieved when the necessary component pieces of apparatus were assembled for the first time. In other words, we may agree that wireless began when electro-magnetic waves were controlled by a telegraphic key at one place and recorded by telegraphic receiving apparatus at another place, for the purpose of transmitting signals from one person to another. The preparatory research work for the transmitting station, *i.e.*, for generating electro-magnetic waves, was done by Hertz in the years 1885 to 1888, and appears to have been prompted by the rivalry between Maxwell's and other theories of electro-magnetism. The laboratory work for the receiving station was done by Lodge in 1889, by Minchin and by Branly in 1890. Lodge's work on the reception of electric waves arose from observing that two metal knobs nearly in contact cohered when a spark occurred near them; Minchin's work was on light-sensitive cells, and his observation of the effects of electric waves was a side issue, but was duly recorded; Branly's investigations were on the diminution of the electrical resistance of contacts between oxidised metals and in masses of filings when sparks were made nearby. Other investigators, such as Hughes, to mention only one, had observed similar phenomena earlier, but it is not necessary for the present purpose to make a complete enumeration on ante-natal events.

Sir Oliver Lodge demonstrated the transmission of signals across a space of thirty yards and through several walls at the Royal Institution, London, on the 1 June, 1894. Wireless telegraphy was then born. On this occasion a filings coherer was used, and the necessity of screening various portions of the receiver and its leads, which afterwards became part of early wireless engineering, was emphasised. Later in 1894, during the summer meeting of the British Association at Oxford, Lodge demonstrated the sending and recording of Morse code signals. He used a Hertzian oscillator with capacity areas made of large copper plates, an induction coil with the usual vibrating interrupter, and a Morse telegraphic key in the primary of the coil. As receiver he used a filings coherer with attached aerial wires for picking up the waves, a trembler of electric bell type operated by the coherer current and serving to shake the filings back to their non-conductive condition, and a Morse inker for recording the dots and dashes on tape. Other telegraphic instruments were employed as alternatives. The following year Popoff, a Russian physicist, added to the recording apparatus a long earthed vertical antenna for catching natural electric waves produced by distant lightning discharges; he had possibly adopted the vertical wire from the patents of Dolbear and other American inventors. By 1895, therefore, every netdful item was ready for the attention of the engineer, and was common general knowledge; some parts of Lodge's apparatus had to be made more powerful, other parts more sensitive, and all of it more reliable and robust before it could be put into the hands of telegraphists for everyday use. Improvements of this practical type —which, not being of physical interest, I must pass over—came rapidly, and the range of action was gradually increased; but until 1897 progress was limited by the use of highly-damped trains of waves. At this date the spark gap at the sending station was situated in a long vertical ware, possibly surmounted by a large metal plate, and the coherer was in another similar antenna at the receiving station. Such an arrangement had a high decrement, and therefore any transmitting station affected every receiving station within range, and only one pair could work at a time.

It is strange that although the subject of electrical oscillations on straight wires was well understood before 1897, no one seemed to appreciate that a straight Hertzian oscillator could have its frequency of vibration reduced at will by the introduction of an inductance coil near its middle. Hertz and others used capacity areas, for instance, sheets of metal, for adjusting the frequency, but never coils. In Europe, so far as printed records can tell us, the earliest use of " tuning " coils in open oscillating circuits was due to Lodge, who appears to have satisfied himself, by laboratory experiments in 1896 and 1897, not only that inductance coils were useful in a Hertzian oscillator for adjusting frequency, but also that their employment brought certain advantages over tuning by capacity areas. The main advantage of inductance over capacity in an open oscillator is that the former prolongs, the latter shortens, a train of oscillations produced by a spark. In consequence, if straight Hertzian oscillators

be used as sending antenna and receiving antenna, and they be tuned to each other by inductance coils, the damping of each is thereby made low, and sharp resonance may be attained. Having made this discovery in his laboratory, Lodge set it forth as the principal feature of his 1897 patent.

Lodge's patent produced a revolution in both thought and practice. Hitherto it had been imagined that the electrical oscillations produced by the spark gap in the aerial possessed a very short wave-length of the same order as the dimensions of the spark balls, just as in the case of the Righi ascillator; and the function of the transmitting antenna had been explained by supposing that the Righi waves ran up the wire and squirted out at the top! This seemed to explain why high wires were needed for long ranges. But now it was seen that, after all, the high wire vibrated as a Hertzian oscillator with a wave-length of the same order of magnitude as the length of the antenna, and that range of signalling was related to length of wave. Moreover, the patent specification disclosed a scheme for exciting a metallically continuous antenna from a spark situated in a branch circuit, thus contradicting the accepted idea that radiation was impossible unless the spark was formed in the antenna. Stranger still, the receiving antenna was shown as a continuous straight oscillator with its tuning coil acting as the primary of a high-frequency transformer, the coherer being connected into the secondary circuit. As we say nowadays, the detector was placed in a coupled circuit; and, by the way, it was pointed out that the coupling could be either direct or indirect, *i.e.*, of the auto-transformer type or the two-coil type. These were all novel principles to the wireless engineer of that date; they were quickly absorbed and elaborated in detail by those grappling with the problem of extending the range of signalling, and have taken their place permanently in practice.

Lodge's patent specification contains many smaller novelties. It describes, for instance, conical antennæ and flat-topped antennæ; variable inductances of concertina type; a self-restoring metal contact coherer with a telephone as indicating instrument; and high-frequency transformers with finely divided iron cores. All these innovations passed into practice in many countries, and they or their descendants are in use to-day. They and the broad principles already discussed are very evidently the product of the laboratory, the work of the physicist rather than of the engineer. Being, in fact, a mine of scientific information and suggestion, the patent specification furnished, during several succeeding years, all the fundamental ideas employed by the engineers who developed commercial signalling plant of the spark type.

In illustration of the last statement, and to put on record another triumph of the laboratory, I may cite the development known as the quenched spark transmitter. The germ of this appears in Lodge's patent, where it is explained that an antenna would become a more persistent oscillator if it were excited by a short-lived spark in a side circuit. The cessation of the spark automatically frees the antenna from the branch circuit and from the dissipation of energy in it. The idea was improved upon by Max Wien in 1906 who, for the purpose of his laboratory measurements, invented a form of gap that ensured rapid quenching. This was developed by the Telefunken engineers into a type of transmitter that has seen world-wide service.

From the year 1900 onwards numbers of workers in wireless sought about for a method of generating continuous waves. The hope of achieving wireless telephony was the incentive, for at that time no one foresaw that continuous waves would be better than spark-waves for telegraphy. The problem was to devise a method of generating continuous waves of frequency at least 100,000 cycles per second. The solution came from an unexpected direction, namely, from the scientific investigation of the properties of an electric arc traversed by alternating currents of low frequency. In 1900 Duddell was pursuing these investigations on carbon arcs, and happened to connect across the arc gap an inductance coil and condenser in series, just as if the arc gap was a spark gap. He was surprised to find that the arc whistled when ignited, and soon discovered that the pitch of the note depended on the magnitudes of inductance and capacity in the shunt circuit, in the same way as in a spark circuit. This highly original work was the first and last accomplished in England on the arc, for our engineers clung to the spark with native tenacity for many years, and developed it to extreme sizes.

The study of the oscillating arc was taken gated the Duddell phenomenon when the up by Poulsen, in Denmark, and he investi-

are burnt in various gases and between various electrodes. By 1903 he discovered than an arc burning in hydrogenous vapour between a copper anode and a carbon cathode was capable of developing currents of the frequencies required for radio-telephony, and of considerable power. This splendid discovery led straight to practical radio-telephony. German engineers developed all the necessary apparatus, including a transmitter absorbing about six kilowatts of power, by 1906. In the hands of American engineers the arc ultimately reached a standard size of a thousand kilowatts.

By 1907 Fessenden's telephony experiments with one of these machines enabled the human voice to be heard across the Atlantic. This ranks as the greatest achievement in wireless up to that date, for, telephony being impossible on long cables, wireless waves thus accomplished what the cable had never done. Fessenden's work with continuous waves was carried on without amplifiers or sensitive detectors; the electrolytic and contact detector were the most sensitive available at that date. This want of a delicate method of reception must have pressed hardly upon him; it certainly hindered the general application of the arc and the alternator to telegraphic, as distinct from telephonic, radio communication. It was under the stress of this need of something specially suitable for the reception of continuous waves that Fessenden invented the heterodyne method of receiving telegraphic signals.

In considering the history of the amplifying valve I shall look steadily at the gathering together of the ideas that culminated in the creation of the modern triode. We shall find that the triode is not in any respect the sort of solution that would be reached by applying the methods of engineering development to a set problem; it was, rather, the fortuitous fruit of the physics laboratory, a by-product of pure physical research.

The first vacuum tube containing a hot filament and a separate electrode with external lead, that is, the first thermionic diode, was made by Edison in 1883. Studies of the thermionic current across the vacuum were conducted by Hittorf (1883), Preece (1884), Elster and Geitel (1887), and Fleming (1885 to 1896). Three years later J. J. Thomson's laboratory took up the problem and, in particular, O. W. Richardson during the next three years pursued his classical researches, usually employing a form of diode that has become typical, namely, a straight or curly filament along the axis of a cylindrical anode. Meanwhile an analogous form of diode in which the source of electrons is a photo-electric surface was being similarly studied. In both cases many of the researches of the date were aimed at measuring the charge and the mass of the particles carrying the current across the vacuous space; and for this purpose other electrodes were sometimes introduced for deflecting or accelerating the particles by an electric field. In certain researches grid-like electrodes appeared for the purpose of accelerating the charged particles to such an extent that they shot through the meshes of the grid electrode. For instance, Lenard, in 1902, introduced an anode of wire gauze, at first so that light could pass through it to the cathode and liberate electrons; but he afterwards used the grid for accelerating the particles through its interstices into the space behind it, where they were collected by a third electrode. This is the first appearance of the principle of the modern triode, so far as printed records inform us. Wulf later used a flat spiral of wire, parallel to the photo-electric cathode. Varley, again, observed in 1903 that when the gas pressure was below about five microns the electrons could be accelerated towards a positive grid so as to be shot through the meshes of the gauze abundantly; at higher pressures ionisation by collision occurred near the grid and stopped the electrons. This ionisation, by the way, gave such tubes their steep characteristic curves. Besides all this experimental work of an abstract nature, various applications of the electric discharge through gases had been made to the rectifying of alternating currents. Thus the scientific atmosphere of the first three years of the twentieth century was thick with material destined for early incorporation in electro-technics. Four independent and almost simultaneous applications demand our attention.

The first application of vacuum tube physics which I have to notice was made by Wehnelt, who, having discovered in 1903 that filaments coated with oxides of rare earths emitted electrons copiously, patented a diode with coated filament as a rectifier in January, 1904. He called this thermionic diode an electric valve. In Germany it is sometimes said that Wehnelt invented the thermionic valve—but this is not strictly accurate; he invented the

coated filament, and he invented the name "valve" perhaps; but thermionic tubes with two electrodes had long been commonplaces in physical laboratories. It is noteworthy that, apart from the valuable invention of the oxide coating, Wehnelt's application is widely used to-day at many transmitting stations for rectifying alternating current, and in the so-called "battery eliminators" of broadcasting sets. About eleven months after Wehnelt, Fleming independently patented the combination of a thermionic diode, a coal and an indicating instrument, to form a circuit in which alternatiug current could be produced and rectified, special stress being laid on the applicability of the circuit for detecting by rectification the feeble alternating currents experienced in wireless receivers. The diode as detector was in the field for several years as a rival to the electrolytic and contact detectors. The third interesting application of vacuum tube physics was made a year later by von Lieben, who proposed to utilise the lateral deflection of a stream of electrons for amplifying. The current to be amplified was intended to cause the deflection—either by charging an auxiliary electrode which then attracted or repelled the stream, or by producing a magnetic field. The fourth application was made a year later in America by de Forest, who, by means of an auxiliary electrode in the form of a grid, controlled the passage of the electrons to an anode by accelerating or decelerating them in their line of motion. This method of control proved, in the course of a few years' development, more effective for amplifying purposes than the method of control by lateral deflection.

(*To be continued.*)

ELECTROLYTIC PRODUCTION OF HYDROXIDES AND HYDROGEN.

By R. SAXON, B.Sc., F.C.S.
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IRON.

We are concerned with the electrolysis of water only.

An iron anode is used, a current of 240 volts, and a cathode of platinum. It is immaterial what is used for the cathode, carbon answers as well as anything. Immediately the current is switched on a storm of bubbles rushes from the cathode, but there are none from the anode. A boiling tube is filled with water and inverted over the cathode. The following take place :—

1. The liquid immediately takes on a raw umber tint.
2. The colour deepens to a burnt umber.
3. A bright red brown transparent flocculence gathers at the top of the liquid in the boiling tube.
4. The liquid takes on a greenish cast, which deepens to an olive green.
5. The liquid everywhere carries a floating scum of red brown hydroxide.
6. A feathery wraith of green transparent growth spreads itself out clinging to the anode.
7. The liquid becomes a green jelly-like fluid except at the bottom of the vessel and the tube where it is colourless.
8. The gas proves to be hydrogen without any oxygen admixture. It ignites most quietly.
10. The green hydroxide must be gathered out of contact with the air. It shows a remarkable tendency to oxidise. It is the ferrous hydroxide.

No matter what cathode is used the liquid immediately takes on the raw umber tint. It is beautifully transparent but gives no reaction to show that dissolved iron is in the liquid. It has au acid reaction to methyl orange. The addition of an acid immediately releases the iron to react with potassium sulphocyanide or ferrocyanide. It is probably in the colloid state and like other hydroxides refuses to react with reagents. The fact that the red hydroxide appears immediately in the cathode tube to be followed later by the green shows that the natural tendency of iron is to form the ferric salt, and that reduction is responsible for the ferrous. When the tube over the cathode is full of gas there is a red brown ring clinging at the top as it stands and a green one lower down. Again the fact that the red brown does not reduce under a gas like hydrogen shows that it is the nascent hydrogen which does the reducing. There are two positive elements attracting the hydroxyl, iron and hydrogen. Unless the latter is nascent and not in bulk the iron wins. If, however, the hydrogen be nascent the following takes place :—

1. No current : $Fe/3HOH($
2. Current on : $Fe(OH)_3(3H$

   Then $Fe(OH)_3/H = Fe(OH)_2/HOH$.

ON THE RELATION OF VITAMINS TO CARCINOGENISIS.

By Waro Nakahara.

The work on the relation of vitamins to malignant tumors has hitherto been concerned mostly with the growth of transplanted tumors. Recently, however, several papers have appeared discussing the possible relation of certain vitamins in the food to the genesis of cancer. This short note is an attempt to indicate the present status of this interesting problem by critically reviewing these papers.

Fujimaki and associates were the first to call attention to the possible role of vitamin A deficiency in the causation of cancer. In 1925 Fujimaki and Masaki reported that a prolonged feeding of rats on a diet deficient in vitamin A resulted in the production of cancer in the fore-stomach, and this investgation was later extended by Fujimaki, Kimura, Wada and Shimada.

Fujimaki's original paper of 1925 includes three experiments, the duration of which were 226—341 days, 59—102 days, and 60—70 days respectively. The vitamin A deficient diet was: dextrin 65 per cent., casein 18 per cent., olive oil 10 per cent., dried bottom yeast 2 per cent. and salt mixture 5 per cent.

It is fair to state that the essential changes described by these authors were hyperkeratosis and hyperplasia and metaplasia of the pavement epithelium, and that they found what they diagnosed as carcinomas only in a few out of a very large number of the rats used in their experiments.

One of these alleged gastric carcinomas was accompanied by a small epithelial nodule in the lung, and this the authors regarded as pulmonary metastasis. Oddly enough, the "primary tumor" of this "metastasis" was one of the less convincing examples of the "carcinomas."

In 1926, Matsuoka in our laboratory reported at the Japanese Pathological Society that he was unable to find any tumor in a large series of rats he maintained on vitamin A deficient diet. As to hyperkeratosis and epithelial hyperplasia, he found them very frequently, not only in the vitamin A deficient group but also among rats receiving a sufficient supply of vitamin A in the form of cod-liver oil or biosterin. That these non-malignant epithelial changes are not necessarily related to vitamin A deficiency was pointed out also by Uyeyama, who used butter feeding in his experiments.

During 1926 to 1927, I myself examined stomachs from some 50 rats maintained on vitamin A deficient diet 10—120 days, separate from Matsuoka's series. These rats were primarily intended for another investigation which Miss Y. Yokoyama and I were then carryinrg on, bnt I improved the opportunity by examining the stomachs of all the rats as they were killed. The vitamin A deficient diet used consisted of horse meat 17 per cent, starch 63 per cent., hydrogenated oil 16 per cent., salt mixture 4 per cent., with the addition of 4 cc of oryzanin per 100 grams of the total other ingredients. Not a single tumor was found among these rats. It frequently happened that a fairly high grade hyperplasia was found in a few isolated cases after a very short period of deficient feeding, say, 10 days, while no noticeable change was seen in some rats that were kept on the same diet for 100 days longer. From this it follows that the epithelial change in question can hardly be regarded as a precancerous condition.

More recently, a number of reports appeared in foreign literature.

In Germany, Erdmann and Haagen (1928) reported 6 out of 83 rats as developing spontaneous tumors after feeding on vitamin A deficient diet. Of these tumors, 3 were adenocarcinoma of the mammary gland, 1 was angioma, and only 2 were papillomas of the stomach. No gastric carcinoma was found.

In England, Cramer reported in 1928 his failure to obtain any tumor by means of vitamin A deficient feeding. He found, however, that warts or papillomatous growths in the fore-stomach are not rare among old rats maintained on an adequate diet not deficient in vitamin A.

In 1930, Sugiura and Benedict in America also failed to observe any tumor formation in the stomach of 108 rats fed on a vitamin A deficient diet recommended by Fujimaki. In the course of their experiment 2 rats developed tumors of the mammary gland, which the authors regarded as spontaneous tumors, justly stating that the finding does not warrant a conclusion that the diet used was a causative factor.

Just recently Tilden and Miller reported detailed histological findings in 11 monkeys maintained for a long time on a vitamin A deficient diet. They found epithelial hyperkeratosis, hyperplasia and metaplasia of epithelium, etc., in most of the monkeys but no tumor was detected.

In the meantime, attention of workers was diverted to other vitamins, and in 1928 Erdmann reported that by feeding rats on a diet exceedingly rich in vitamins B and D, 3 out of 80 animals were found to produce mammary adenocarcinomas. Under the same dietary condition only 1 out of 100 other rats produced papilloma of the stomach.

Interest in the possible role of excess vitamin D in the production of cancer was aroused by the work of Collazo, Fuentes and Bubino, who reported in 1928 that hyperphysiological doses of vitamin D produces in rats diffuse calciosis and tumor in the wall of the stomach, in addition to the well known premature calcification of the cartilages of the points, main arteries, etc.

Through the kindness of Dr. M. Sumi of this laboratory, I recently had the opportunity to examine stomachs from 11 rats which had been fed with hyperphysiological amount of vitamin D (irradiated ergosterin, Sumi). The daily amount of vitamin D administered was 10 mg per rat, which is about 100,000 times the usual therapeutic dose. Of these 11 rats,5 received excess vitamin D for 63 days, and 6 for 24 days.

Minute and careful examination disclosed no gastric lesion of any sort except in a single case. This rat was under excess vitamin D treatment only 24 days. The lesion consisted of three small keratotic nodules of irregular shape existing in the fore-stomach near the border line between it and the glandular part. Upon microscopical examination, however, it turned out to be merely a possible early papilloma —not unlike those desribed in rats under vitamin A deficient feeding. It is significant that all the rats killed after 63 days of excess vitamin D feeding proved to be entirely free from any gastric lesion.

One of the very confusing factors in experiments of this sort is the frequent occurrence of spontaneous tumors in old rats and mice. In fact, spontaneous development of tumors in animals under dietary experimentation has often been reported. For example, McCarrison described an early carcinoma of the pylorus of the monkey fed for 51 days on vitamin B deficient diet. Sugiura found a carcinoma in a rat underfed for a long time. The diet was complete but reduced in quantity to one-third of the normal food requirement.

In view of these facts, the occasional tumors, which are, as is well known, not at all rare among old laboratory animals, especially in certain strains of mice and rats.

It is not entirely inconceivable that the dietary factors may so modify the bodily constitution of the animals that the inherent tendency of such an animal to produce cancer may be accentuated. The wide spread histological changes consequent on faulty feeding, such as hyperkeratosis in vitamin A deficiency, or premature calcification in excess supply of vitamin D, may eventually be shown to have some relation to the ultimate development of cancer. It is, I believe, in this very broad sense that Saiki and others have so emphasized the dietary aspect of cancer etiology. It would seem strange, however, that any malnutrition or deficient feeding should ever be held up as a possible cause of cancer. This idea is contrary to the generally accepted view that cancer is most frequently a disease of persons showing hypernutrition, and that slender, pale, ill-nourished types are seldom afflicted with the disease. Cohnheim classified 279 cases of cancer of the digestive organs according to their body weight, and found that as many as 247 of them were patients of heavy type, the remaining 32 being of slender type. The cancer mortality in prisons, asylums for the aged, Roman Catholic convents and monasteries, etc., where the living conditions are not comparable to those of the wealthy, is known to be exceptionally low.

Summing up in conclusion, it is obviously impossible at the present state of our knowledge to regard either vitamin A deficiency or hypervitaminosis D as a direct causative factor in cancer, inasmuch as experimental production of cancer by these dietary means must be considered yet unattained.

MERCHANDISE MARKS ENQUIRY.

POLISHING WHEELS, DISCS AND BOBS.

The Standing Committee appointed by the Board of Trade will hold an enquiry at 11.30 a.m. on Monday, 9 February, and (if necessary) at 10.30 a.m. on Tuesday, 10 February, as to whether the following descriptions of imported goods should be required to bear an indication of origin :—

Polishing wheels, discs and bobs made wholly or mainly of felt.

The enquiry will be held at the Board of Trade Offices, Great George Street, London, S.W.1. Communications should be addressed to the Secretary, Mr. E. W. Reardon, at that address.

SEVENTY YEARS AGO.
From the Chemical News, Mar. 3, 1860.
RESEARCHES ON THE ORGANO-METALLIC RADICALS.

By M. Auguste Cahours.

Action of Magnesium on the Iodides of Ethyl and Methyl.—Magnesium, like zinc (which it resembles in many respects), appearing only able to form a single stable grouping of the form MgX, ought only to form a single compound with ethyl and methyl, and experiment shows that such is really the fact. If we place some filings of magnesium in a long and stout glass tube of small diameter, and pour on the metal a few cubic centimetres of iodide of ethyl, a lively reaction ensues, accompanied by a notable elevation of temperature. The action is moderated by affusions of cold water, and when the tube returns to the temperature of the air it is sealed, placed in an oil bath, which is heated to between 120° and 130° C. and the temperature kept within these limits for some hours. A solid white mass is then found in the tube composed of iodide of magnesium, some unaltered iodide of ethyl, and finally a colourless, very volatile liquid, possessing a strong alliaceous odour, which takes fire in the air, and decomposes water with violence when thrown upon it. To separate this substance from the rough product, the contents of the tube are introduced into a small retort previously filled with hydrogen, aud distilled at a moderate heat. The iodide of ethyl and the new substance pass over while the earthy iodide remains behind in the retort. By properly managed rectifications of the distillate the inflammable product can be separated from the excess of hydriodic ether. The analysis of the liquid gave the following ptrcentage results :

					Theory
C	...	54.54	4C	... 24	58.53
H	...	11.42	5H	... 5	12.19
Mg	...	11.42	Mg	... 12	29.28
					100.00

The error in the carbon and hydrogen observed in this analysis depends upon the presence of a small quantity of hydriodic ether, of which it is almost impossible to deprive the product. I redistilled the same liquid in a current of hydrogen, and after rejecting the first that came over, the new specimen yielded :

Carbon	55.20
Hydrogen	11.50
Magnesium	—

Here, as in the preceding analysis, the carbon and hydrogen are in excess; but the behaviour of the product with water, its mode of formation, and the manifest analogies with zinc ethyl which it presents can leave no doubt as to its real formula. It corresponds with the oxide of magnesium, ethyl replacing the oxygen.

Iodide of methyl behaves with magnesium just in the same way as the iodide of ethyl : the action is lively; heat is evolved, and a white mass is formed which by distillation is separated into iodide of methyl, and a strongly-smelling mobile liquid, inflammable in the air and decomposing water with the disengagement of marsh gas, separating at the same time flakes of magnesia.

By the action of magnesinm on iodide of ethyl, a large quantity of gas is produced. Some of this is absorbed by bromine with the formation of bromated Dutch liquid. The part on which bromine does not act can be partially liquefied by exposure to extreme cold, and the observations of Frankland seem to show the presence of some carbide of hydrogen, C_8H_{10}. The action of mangesium on iodide of ethyl then is exactly like that which zinc exerts on this ether, and may be formularised in a similar manner.

$$C_4H_5I+2Mg=C_4H_5Mg+MgI.$$
$$2(C_4H_6I)+2Mg=2MgI+C_8H_{10}$$
$$C_8H_{10}=C_4H_4+C_3H_6.$$

Aluminethyl.—Aluminium in the cold exerts no action on iodide of ethyl : at the temperatures of 100° C. however, the attack hecomes very manifest, and by maintaining the mixture for 24 hours at 130° in sealed tubes the reaction is complete. Thick white vapours are seen at the commencement, the metal gradually disappears and a viscous liquid is obtained which fumes abundantly in the air. The contents of the tube placed in a retort filled with bydrogen and distilled yields a colourless liquid with a penetrating disagreeable odour, which presents some analogy with altered oil of turpentine. It fumes in the air, and decomposes water with an explosion, producing alumina and hydriodic acid, as well as an inflammable gas which burns with a pale blue flame. It boils between 340° and 350° C. It contains aluminium, iodine, and carbon and hydrogen in the proportions which constitute ethyl. On analysis, the product gave results which agree with the formula :

$$C_{12}H_{15}Al_4I_3=Al_2I_3.Al_2(C_4H_5)_3, \text{ or}$$

12C	72.0	18.78
15H	15.0	2.86

4Al	54.4	10.38
3I	381.0	72.98
	522.4	100.00

When this liquid is allowed to fall drop by drop into a bottle of chlorine or oxygen, it immediately takes fire and burns with a violet flame. The combination belonging to the same type as alumina, we may consider it as formed of an equivalent of iodide of aluminium with an equivalent of alumin-ethyl. Zinc ethyl attacks it quickly and there is formed the iodide of zinc, and a very inflammable liquid which is probably *aluminethyl*. The iodide of methyl behaves with aluminium just as the iodide of ethyl. A colourless liquid is produced which contains aluminium, iodine and the elements of methyl. Like its ethylated homologue this compounds burns in the air, and quickly decomposes water, forming the hydride of methyl.

Glucinium acts strongly on the iodide of ethyl when heated with this liquid in sealed tubes. As in the former cases a solid substance is obtained, which by distillation furnishes a liquid having the power of decomposing water with the disengagement of an inflammable gas ;the mode of action appears analogous to that of aluminium.

TANTALUM AND NIOBIUM.

Before the extensive use of wireless in the United States the commercial development of tantalum had been very small and spasmodic. The demand for a cheap and simple means for converting alternating electric current into direct, however, drew attention to the possibilities of metallic tantalum. This demand for the metal led to its production on a much larger scale than hitherto, thus making it available for other commercial uses and enabling its properties to be more thoroughly investigated than had hitherto been possible. The metal is stated to be suitable for many chemical, physical and industrial purposes for which it has become a rival to platinum.

The Imperial Institute has just issued a monograph on this rare metal, and its less-known sister metal, niobium, giving a considerable amount of information concerning the properties and uses of both. The book is devoted mainly to descriptions of the more important occurrences of tantalum and niobium minerals, the chief sources of supply being Western and North Australia.

FIELD WORK OF THE GEOLOGICAL SURVEY. 1930.

Canada is expecting a vigorous revival of the mineral industry as soon as recovery from the present general industrial depression begins. The natural resources of the country will be heavily drawn upon to replace depleted stocks of goods of all kinds, and minerals constitute one of the most important of Canada's resources.

In view of the probably increase in the demand within a reasonable time for minerals and mineral products, the Geological Survey, Department of Mines, continued its policy during the summer of 1930 of carrying on extensive and intensive investigations into the geology and mineral possibilities of areas of special interest throughout the country. Nearly sixty parties were sent to the field.

The areas that have proved most productive of metallic minerals are those parts of Ontario, Quebec and Manitoba, underlain by Precambrian formations, and those parts of the Western Cordillera of British Columbia and Yukon in which contact relations exist between igneous intrusives and older formations. About the same number of field parties was sent, therefore, to make surveys in the Western Cordillera and in the Precambrian area as was sent to all other parts of Canada. In Yukon and British Columbia several parties were engaged in mapping areas in which one might expect to find minerals that had had their origin in solutions given off by the great mass of intrusive rocks forming the Coast Range. In the precambrian area several parties were engaged in carrying on geological work in parts of Manitoba, Ontario, Saskatchewan and Quebec where mineral discoveries have heen made or where geological conditions exist favourable to the occurence of minerals. One party was engaged in mapping tha geology to the south of Great Slave Lake, Northwest Territory, and another in the vicinity of Rongin inlet on the west coast of Hudson Bay.

Topographical engineers of the Survey had charge of thirteen parties making high grade contoured topographical and geographical maps for use of engineers and to serve as a base for laying down geological data. Three parties carried on investigations into the applicability in Canada of different geophysical methods employed or recommended for the search for mineral deposits.

GENERAL NOTES

ECONOMIC CONDITIONS IN THE ARGENTINE REPUBLIC.

(Issued by the Dept. of Overseas Trade).

In his introduction the Commercial Counsellor observes that the Argentine Republic has been largely free from the abnormal economic conditions which have prevailed in so many countries during the post war period. Manufacturing industries are not unduly developed and produce for home consumption only, thus lesesning the likelihood of over-production or unemployment. It is also worthy of note that the value of Argentine exports per head of the population, in a typical year, was nearly the same as that of the United Kingdom.

Attention is drawn to the period of prosperity enjoyed by the Argentine Republic during the first half of 1929. These prosperous conditions were not, however, continued during the latter part of the period under review.

The Commercial Counsellor judges from existing conditions that there are good prospects for increased British exports to Argentine in 1931, which year will be noteworthy for the holding of the British Empire Trade Exhibition to be opened by the Prince of Wales in Buenos Aires in March. This is the first national industrial exhibition to be organised by any country in South America, and has the support of the British Government and of leading firms in the majority of British industries.

After a close review of the financial situation the Commerical Counsellor deals, in chapter II, with the foreign trade of the Argentine Republic. This careful analysis, occupying 45 pages of the report when read in conjunction with the very detailed import and export statistics given in appendices 1—VI, forms a most valuable contribution to the study of the Argentine market, which is especially relevant in view of the forthcoming Exhibition. A notable feature of this chapter is the section on "marketing organisation and local representation" which will be found on pages 59 to 65.

Chapter III contains a comprehensive account of production and industry in the Republic, commencing with agricultural and pastoral production followed by some particulars of the trade in meat, wool and other animal products. Notes on petroleum production and on the manufacturing industries are given at the end of the chapter. The chapter on transport and communications, which follows, affords some useful information in regard to extensions and works carried out on the railways during the past financial year and of developments in prospect. Social questions including labour matters, employment, etc., are reviewed, in the fifth and last chapter of the report.

PROGRESS IN THE CHEMICAL INDUSTRY OF THE U.S.S.R.

The director of the Fertiliser Institute at Moscow has studied a new process for the production of superphosphates from poor phosphates. This process is likely to be of great value to the regions abounding in poor phosphates, and having no sulphuric acid.

At the Konstantinovka works (Donetz) 67 tons of phosphate have been treated. The average proportion of anhydride distilled was 90 per cent.

The new formaldehyde plant at the Kuskowsker factory of the Ljessochim Trust is now working satisfactorily at its rated capacity of 200 tons a month of 40 per cent. formaldehyde solution.

A second plant at the same factory is to have an annual capacity of 2,400 tons, and is almost ready to start up.

The Trust is to erect synthetic methyl alcohol plants at Rubeschnaja, and Stalingrad.

The first camphor plant has almost been completed at Leningrad, and belongs to the Leningrad Chemical Trust. It has a capacity of 400 tons of camphor a year.

During the first eight months of the current business year, the exports of Russian petroleum products amounted to 3,038,000 tons, an increase of no less than 37 per cent. on the exports during the corresponding period of the previous year.

The Trans-Caucasian Chemical & Mining Trust will erect a lithopone factory at Kutais, with an annual capacity of 12,000 tons, at a cost of 2,500,000 rls.

The Trust will erect a copper sulphate factory in Armenia with a capacity of 2,000 tons a year; and sulphuric acid works in Gandscha and Allawerdy with a capacity of 5,000 tons a year each.

It will also erect a potassium permanganate plant in Kutais (capacity 3,000 tons a year) and a large electrolytic and bleach plant in Baku.

The Trust has also commenced to build one of the largest calcium carbide and cyanamide factories in Europe, which will have a capacity of 10,000 tons a year, and will cost about 10,000,000 roubles.

CHEMICAL AND METALLURGICAL CORPORATION.

The above announce that all matters, the subject of litigation between the Corporation and Mr. Stanley Smith, late Managing Director, have been amicably settled by mutally satisfactory arrangement between the parties.

TRADE WITH BRITISH WEST INDIES.

Broadly speaking, the chief demand in these islands is for miscellaneous articles of the cheapest quality, writes H.M. Trade Commissioner, Port of Spain, Trinidad. The growth of Canadian trade has been more at the expense of the United States than of the United Kingdom.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, January 29.

The following papers were read :—

The Origin of the Mesoderm in the Gastropod Viviparus (=Paludina). By W. FERNANDO. Communicated by E. W. MacBride, F.R.S.

The Origin and Development of the Pericardium and Kidneys in Ostrea. By W. FERNANDO. Communicated by E. W. MacBride, F.R.S.

Studies on Echinoderm Oogenesis. I. Antedon bifida (Pennant). *II.* Asterias rubens (Linn). By L. A. HARVEY. Communicated by J. H. Ashworth, F.R.S.

The Pupillary Mechanism of the Teleostean Fish Uraniscopus scaber. By J. YOUNG. Communicated by E. S. Goodrich, F.R.S.

The following papers were read in title only :—

Studies in Tunicate Development. By N. J. BERRILL. Communicated by D. M. S. Watson, F.R.S.

The Heat of Rigor of Mammalian Muscle. By E. C. SMITH. Communicated by Sir William Hardy, F.R.S.

The Accumulation of Electrolytes in Plant Cells.—A Suggested Mechanism. By G. E. BRIGGS. Communicated by F. F. Blackman, F.R.S.

The Relation Between the Pituitary Body and the Gonads. III. Fractionation and Dilution of Ovary-Stimulating Extracts. By M. HILL AND A. S. PARKES. Communicated by C. Lovatt Evans, F.R.S.

Metabolic Changes Associated with Pigmentary Effector Activity and Pituitary Removal in Xenopus lævis. I., II. By E. CHARLES. Communicated by H. H. Dale, Sec., R.S.

GEOLOGICAL SOCIETY OF LONDON.

January 14.

Prof. E. J. Garwood, M.A., Sc.D., FR.S., President, in the chair.

The following communication was read :

Additional Fossils from the Cambrian Rocks of Comley (Shropshire). By EDGAR STERLING COBBOLD, D.Sc., F.G.S.

This paper is intended as a supplement to those that appeared in the Society's Quarterly *Journal* in 1910, 1911, 1913, and 1921.

It is rendered necessary by the collection during the past twenty years of a few forms new to the Comley area and other specimens which throw light on species already described.

Species referred with reserve to *Micmacca* Matthew in 1910 are not confidently placed between *Protolenus*, *Strenuella*, and *Micmacca* are noted. The very plentiful *Ptychoparia attleborensis* Shaler & Foerste is placed under Walcott's genus of the Eodiscidæ, *Pagetia*, on the strength of an enrolled specimen of the complete dorsal shield. Some six or eight specimens of *Weymouthia nobilis* Ford throw considerable light on this species. Evidence is put forward for the presence of *Paradoxides sjögrenia*. A new genus is proposed for an undescribed Lower Cambrian trilobite, which seems intermediate between *Dorypyge* and *Centropleura*.

Certain Hyolithidæ are noted or described for the first time; Cystids, a Polyzoan, and one specimen of *Archæocyathus* (?) are recorded from the Lower Cambrian.

Wednesday, January 28.

The South-West Highland Sequence. By JOHN FREDERICK NORMAN GREEN, B.A., F.G.S.

In 1923, the following sequence was proposed by the Author for Islay :—

Dark chloritic slates.
Calcareous passage beds.
Grey limestone.
Black sandstone (lenticular).
Arkoses with banks of nordmarkite-conglomerate.
(Line of erosion.)
Dolomitic flags.
Siliceo-argillaceous flags.
White quartzite with rusty cross-bedded films.
Slightly felspathic quartzite.
Pebbly quartzite.

This sequence runs through Jura, Scarba, and the Garvellachs, the quartzites, however, thinning out.

It is considered that the present succession near Ballachulish can be parallelled in detail with Islay. On attempting to apply the result to the neighgouring areas of Glencoe, Onich and Cuil Bay, it appears that the following amendments to current views are involved :—

1. The Appin Phyllites and Cuil Bay Slates must be identical with the Leven Schists (siliceo-argillaceous flags).

2. The Appin Limestone must be identical with the ' cream-coloured edge of the Ballachulish Limestone ' (dolomitic flags).

3. The dark part of the Ballachulish Limestone must be distributed into two horizons; one corresponding to the grey limestone of Islay, the other a black limestone which comes in above the dolomitic flags and below the line of erosion.

The evidence supporting these amendments is then given.

As a result, the Eilde Flags of Loch Linnhe fall into position, and the structure of the Ballachulish-Appin area can be explained without large-scale dislocations, as can also the neighbouring Benderloch area, if the Garbh Ard Quartzite is placed with the arkoses.

The sequence about Tayvallich and Crinan is, when the ' Crinan Quartzite ' has been divided into arkoses, flags, true quartzite and conglomerate, comparable with the Islay sequence, allowance being made for a volcanic series near the line of erosion. The beds are followed up to the neighbourhood of Loch Awe, where the volcanic rocks replace part of the sequence, which is, however, complete in the neighbourhood of Kilchrenan. The Loch Avich slates and grits are correlated with the dark chloritic slates and higher beds in Islay.

Thus, the three areas, Islay-Jura, Ballachulish-Appin and Tayvallich-Loch Awe, are comple synclines of correlated rocks. Between these synclines appear grey calcareous phyllites. Between the phyllites and the flags or discontinuous quartzite occur shallow-water beds, composed essentially of quartzitic conglomerate and calcareous sandstone, accompanied usually, but not always, by black slate. These beds, which may be referred to as the ' Shore Series,' run north-east through Islay and Jura as the ' Jura Slates '; thence through many Islands, and on the mainland, as the ' Easdale Slates.' They can be picked up on the opposite side of the phyllites near Kilmelfort, whence they can be traced south-westward into the ' Ardnoe type ' of the Crinan area. They recur in Knapdale, and, as 'Shira Limestone ', can be followed for 40 miles north-eastward again; they appear on the opposite side of Loch Awe east of Kilchrenan, and pass through the Pass of Brander to the edge of the Cruachan granite at Loch Etive. The granite-margin gradually rises in the sequence till it touches the dolomitic flags in Glen Ure, and then descends again to the Shore Series in the sections which have been called ' the Windows of Etive.'

In the opposite direction, through the Pass of Brander, the Shore Series is met with about Dalmally, where it is overlain by quartzite passing into white quartzite of the Islay type, above which come flags altered to the condition of Moine schists.

The conclusion is that the structure of the whole of the Dalradian rocks of this part of the South-west Highlands can be explained by the following sequence :—

	Chloritic grits.	
	Chloritic slates.	
	Grey limestones.	
Basal Beds	Black slates, above or below arkoses, with banks of nordmarkite-conglomerate. Either may be absent.	
	(Line of erosion.)	
	Black Limestone.	
	Dolomitic flags.	
	Siliceo-argillaceous flags.	
	White quartzite	May thin out
	Slightly felspathic quartzite	May thin out
Shore Series	Quartzitic conglomerate and calcitic sandstone, usually with black slate.	
	Grey calcareous phyllites.	

CORRESPONDENCE.

HAMPERING A VIGOROUS INDUSTRY.

(*To the Editor of* THE CHEMICAL NEWS.)

Sir,

The steady development of the gas industry at a time when so much official encouragement is being given to its rival, electricity, is apt to be overlooked.

Hampering legislation, no doubt neccescary at the time, was imposed when gas was first introduced, but the industry, which is practically 100 per cent. British, is still forging ahead, and employs nearly three times as many workers as do the electricity supply undertakings.

The increase in the number of consumers last year is, perhaps, sufficient evidence of the indispensability, the utility and the popularity of gas, but the whole industry and its 113,000 employees view with the gravest concern the increasing number of unfair restrictions which are being imposed on the use of gas in municipal houses. In nearly 100,000 houses in this country the tenants are not allowed to choose the form of lighting or heating which they prefer.

In no fewer than thirteen districts have local authorities prohibited the use of gas for any purpose whatsoever on their estates, and in forty-seven other cases, specific uses of gas (*e.g.* for lighting or for gas fires) are forbidden.

These figures do not include the 26,000 houses upon which the London County Council has placed similar restrictions. In working-class houses in South London, candles and oil-stoves may be found in use, simply because tenants are not allowed to have gas and find that electricity is beyond their means.

British prosperity has, in the past, been built upon fairplay and freedom of enterprise, and when Ministers of the Crown neglect their official duties to further the cause of a particular industry, it is time to protest. May I urge that the gas and electrical industries be placed upon the same basis of freedom, so that they may develop unhampered by official interference.

Yours faithfully,

S. S. OGILIVIE,
Joint Manager,
National Gas Council.

NOTICES OF BOOKS.

Practical Physical Chemistry. By PROF. A. FINDLAY, M. A., D.Sc. Fifth Edition. Pp. XII + 312. London: Messrs. Longmans, Green and Co., Paternoster Row, E.C. 1931. Price 7s. 6d.

Prof. Findlay's *Practical Physical Chemistry*, first published in 1906, remains the standard students' guide and has now reached its fifth edition. New experiments have been introduced in connection with gaseous dissociation, the vapour pressure of liquids, the viscosity measurements of highly viscous fluids, new potentiometric measurements and the use of indicators in estimating hydrogen in concentration. Other new matter has been introduced whilst compression has taken place in certain of the less important earlier text. As now published, this work covers a complete and up-to-date course of practical physical chemistry.

Alkylperoxyde und Ozonide. By DR. ALFRED RIECHE. Pp. VIII + 172. Dresden and Leipzig: Theodor Steinkopff. 1931. Price 10 marks.

The author of this monograph has collected much information, scattered through the literature during the last few decades, dealing with organic peroxides and the ozonides. Hydrogen peroxide and "ozonised" oxygen have long been among the useful reagents employed by organic chemists, especially in Germany. In addition to H_2O_2 (including the anhydrous compound), dialkyl and dianyl peroxides (*e.g.*, $CH_3O.OCH_3$) are finding applications not only for special research purposes but in industry as well. The properties of whole series of organic peroxides are being worked out, especially their optical characteristics (refraction and absorption phenomena).

The ozonides obtained when ozone (and also oxozone, O_4, which the author dismisses rather briefly) combines with compounds containing unsaturated ethylenic bonds, have proved useful in separating and identifying certain more complex compounds. These stable compounds have been studied both in regard to their molecular constitution, available oxygen and their physical properties including parachors. Although not a complete survey of the subject, the book is a welcome contribution to a relatively little studied field.

Kolloidwissenschaft Elektrotechnik und Heterogene Katalyse. By PROF. WO. OSTWALD. Pp. 113. Dresden and Leipzig: Theodor Steinkopff. 1930. Price 5 marks.

This is a reprint of Prof. Ostwald's articles on the same subject in the *Kolloidchemisch Beiheft* last year and is intended as a survey and extension of our knowledge of the disperse system, the dimension of colloidal particles, their formation, technical applications and heterogeneous catalysis. To his original remarks he has added a few comments and offered explanations and views on various points.

Mrs. Muriel Wheldale Onslow, author of "Practical Plant Biochemistry," has written two volumes dealing with the theoreti cal side of this subject. The first of these, "The Principles of Plant Biochemistry," will be published immediately by the Cambridge University Press.

ACCIDENT PREVENTION CALENDAR 1931.

Accident Prevention Calendar, 1931, published by Accident Prevention and Welfare Publications, Ltd., 321 High Holborn, W.C.1, at 4d. contains a comprehensive exposition of everyday accidents, their causes and prevention. It is compiled on interesting and clear lines, and the whole calendar of 64 pages, and more than 60 illustrations will no doubt prove helpful to the Accident Prevention Propaganda.

ROADWAY TIME TABLES.

The Second Winter Edition of the Roadway Time Tables, Bookings and Publications, Ltd., Roadway Corner, Warwick St., London, W.1, includes over 4,000 services which serve practically every town in England, Wales, and Scotland. The fares are approximately two-thirds of the ordinary third-class railway fares.

Vol. XIII (1929) of the *Abridged Scientific Publications* of the Kodak Research Laboratories has just been published and contains over 30 contributions which have appeared previously in extended forms in various scientific and photographic journals.

All are concerned with some phase of the application of scientific knowledge and method to the elucidation of the problems and processes of photography.

OFFICIAL PUBLICATIONS RECEIVED.

U.S. GEOLOGICAL SURVEY.

DEPARTMENT OF THE INTERIOR.

The Coal Fields of the United States. General Introduction. By Marius R. Campbell. Ohio by J. A. Bownocker. Professional Paper 100.

Geologic History of the Yosemite Valley. By F. E. Matthes. Professional paper 160. Price $1.10.

Surface Water Supply of the United States, 1926. Part III Ohio River Basin. By N. C. Grover, Chief Hydraulic Engineer. Water Supply Paper 623. Price 50 Cents.

Surface Water Supply of the United States, 1926. Part VIII Western Gulf of Mexico Basins. By N. C. Grover, Chief Engineer. Water Supply Paper 628. Price 35 Cents.

Surface Supply of the United States, 1927. Part VI Missouri River Basin. By N. C. Grover, Chief Hydraulic Engineer. Water Supply Paper 646. Price 20 Cents.

Surface Water Supply of the United States, 1927. Part VII Lower Mississippi River Basin. By N. C. Grover, Chief Hydraulic Engineer. Water Supply Paper 647. Price 20 Cents.

Surface Water Supply of the United States, 1927. Part VIII Western Gulf of Mexico Basins. By N. C. Grover, Chief Hydraulic Engineer. Water Supply Paper 648. Price 20 Cents.

Surface Water Supply of Wawii. July 1, 1926, to June 30, 1927. N. C. Grover, Chief Hydraulic Engineer. Water Supply Paper 655. Price 25 Cents.

Boundaries, Areas, Geographic Centres and Altitudes of the United States, with a brief record of important changes in their territory and government. By E. M. Douglas. Buletin 817. Price 50 Cents.

Notes on the Geology of Upper Nixina River, Alaska. By F. H. Moffit. Bulletin 813-D. Price 15 Cents .

A Graphic Mistory of Metal Mining in Idaho. By C. P. Ross. Bulletin 821-A. Price 10 Cents.

Bituminous Sandstone near Vernal, Utah By E. M. Spieker. Bulletin 822-C. Price 10 Cents.

Mineral Industry of Alaska in 1921, and Administrative Report. By P. S. Smith Bulletin 824-A. Price 20 Cents.

Fifty-First Annual Report of the Director of the Geological Survey, of the Secretary of the Interior, 1930. Price 15 Cents.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Wednesday, February 11, at 8 p.m.—Ordinary Meeting. "New Motives for Textile Designs." Demonstration by Polarised Light of Micro-Crystallisation. By F. G. Wood.

MANCHESTER CHEMICAL SOCIETIES.

INSTITUTE OF CHEMISTRY.

Thursday, February 5, at 7 p.m., in the Manchester, Ltd., Royal Exchange.—Prof. F. L. Pyman, Ph.D., F.I.C., F.R.S.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

Friday, February 6, at 7 p.m., at Milton Hall, Deansgate—Members' Evening.

Friday, February 6, at 7 p.m., at Engineers' Club, Manchester.

(I) "Plant Used in the Manufacture of Synthetic Resins." By A. Fraser.

(II) "Synthetic Resins." By Dr. E. E. Walker and E. A. Bevan.

THE INSTITUTE OF METALS.

LONDON LOCAL SECTION.

Thursday, February 12 at 7.30 p.m., in the Rooms of the Society of Motor Manufacturers and Traders Ltd., 83, Pall Mall, S.W.1.—"Electrolytic Processes in Metallurgy." By J. T. Ellingham, Ph.D., A.R.C.S. (Joint Meeting with the Electroplaters and Depositors Technical Society).

NORTH EAST COAST LOCAL SECTION.

Tuesday, February 10 at 7.30 p.m. in the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. —"Stress in Metals." By A. Wragg, B.Sc.

SCOTTISH LOCAL SECTION.

Monday, February 9 at 7.30 p.m. in the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow.—"Gas Refinement and Alloys." By D. R. Tullis.

SHEFFIELD LOCAL SECTION.

Friday, February 13 at 7.30 p.m. in the Non-Ferrous Section of the Applied Science Department of the University, St. Georges Square.—"The Application of High-Nickel Nickel-Copper Alloys and Pure Nickel in Industry." By N. C. Marpits, M.Sc.

SWANSEA LOCAL SECTION.

Tuesday, February 10 at 6.15 p.m. at the Y.M.C.A.—"Application of Copper to the Building Trade." By J. Frith, M.Sc.

THE ROYAL INSTITUTION.

21, Albemarle St., W.1.

Tuesday, February 10 at 5.15 p.m.—"The Raman Effect." By Sir William Bragg, K.B.E., M.A., D.Sc., F.R.S., M.R.I.

Thursday, February 12 at 5.15 p.m.—"Nature of Physical Science." By Herbert Dingle.

Friday, February 13 at 9 p.m.—"Ultrasonics: Some Properties of Inaudible Sound." By F. Lloyd Hopwood, D.Sc., M.R.I.

OIL AND COLOUR CHEMISTS ASSOCIATION.

Friday, February 6 at 7.0 p.m. at Milton Hall, Deansgate, Manchester.—Members' Evening.

THE OPTICAL SOCIETY.

Thursday, February 12, at 7.30 p.m., at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington.—Ordinary Meeting.

UNIVERSITY OF LONDON.

ADVANCED LECTURES IN BOTANY.

A Course of Three Lectures on "Growth Problems in Plants" will be given in the Metallurgical Lecture Theatre, Imperial College, Royal School of Mines, Prince Consort Road, South Kensington, S.W.7, by F. G. Gregory at 5.30 p.m. on Tuesdays, 10, 17 and 24 February, 1931.—

Lecture I. —"The Formal Aspect of Growth."

Lecture II. "The Interaction of Factors in Plant Growth."

Lecture III.—"Theories of Growth."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

1,292.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of fatty acid nitrile. January 14.

Specifications Published.

340,939.—Dreyfus, H. — Manufacture of aliphatic acids and esters.

341,083.—*Jager, Dr. A., and Herold Akt.-Ges.*—Decolourizing phenol-formaldehyde artificial resins condensed by means of ammonia.

341,047.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of nitrogen compounds having hydrogenated ring systems.

341,120.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of 6-aryl-amino-2-naphthols.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

BIDDIBLACK.

518,743.—*Chemical substances used in* manufactures, photography or philosophical research, and anti-corrosives. — Bideford Black, Ltd., 110, Cannon Street, London, E.C.4. January 21.

CLAYCOL.

518,098.—*Chemical substances used in* manufactures, photography or philosophical research, and anti-corrosives.—H. D. Pochin and Co., Ltd., 13, Worsley Street, Salford, Manchester. January 21 (Associated).

PARALENE.

516,280.—A chemical preparation applied to finished textiles to prevent attack by larvæ, moth and other insects, and for preventing mildew.—British Dyestuffs Corporation, Ltd., Hexagon House, Blackley, Manchester. January 21 (By Consent).

PLANTPIC.

517,163.—Chemical insecticidal and fungicidal *substances for agricultural* and horticultural purposes.— Harpic Manufacturing Co., Ltd., 2 to 14, Staple Street, London, S.E.1. January 21.

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or *How to Reason Correctly.* By J. E. Roscoe, M.A., Oxon.

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CONFESSIONS OF GREAT SOULS.
By the Rev. J. E. Roscoe, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

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THE CHEMICAL NEWS

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BOOKS FOR SALE.

There are many books of Scientific and Historical importance for sale at the Chemical News Office at reasonable prices. List and Prices will be sent on application to the Manager, Chemical News, Merton House, Salisbury Square London, E.C.4.

THE ELECTRO-REDUCTION OF ACETALDEHYDE AT THE DROPPING MERCURY CATHODE.

By I. SMOLER.

In 1925 M. Shikata[1] published his polarographie investigation of some fermentation products present in wine and beer, in which the electro-reduction of aldehydes are described.

Another electro-reduction of aldehyde described M. Shikata and I. Tachi[2] in their study of the reduction potential of iso-valeraldehyde, the value of which, -1.55v., is near to that of acetaldehyde.

The aim of the present author's work was the investigation of the mode of reduction of acetaldehyde from its pure solutions and the quantitative estimation of acetaldehyde in vinegar, as regards the limit of the sensitivity of the polarographic method.

Electrolytes, in the solutions of which the reduction of acetaldehyde could be most distinctly observed, were salts of lithium and lithium hydroxide, since lithium exhibits the most negative cathodic potential of all cations at the dropping mercury cathode.

The acetaldehyde of ordinary purity was used for solutions. These were prepared from *m*/10 to *m*/10.000: in the majority of experiments the solutions contained *n*/100 and *n*/50 lithium chloride.

The galvanometer had the sensitivity 10^{-8} amp. per *mm*.

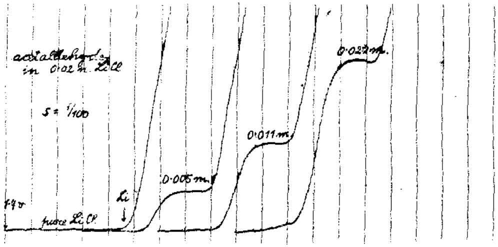
First it was ascertained that the diffusion or saturation currents, shortly denoted " waves ", art strictly proportional to the concentration of acetaldehyde (see polarogram 1).

NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

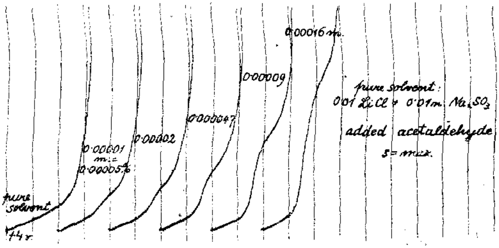
They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.



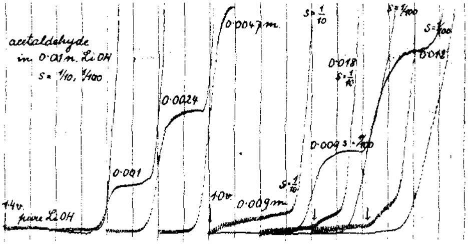
Polarogram 1.

The electrolysis was chiefly carried out in beakers with the solution open to the air, seldom in closed electrolytic vessels from which air was driven out by hydrogen. In air, owing to the presence of oxygen in solution, only $^1/_{10}$ of the maximal sensitivity of the galvanometer could have been used, which revealed the presence of *m/10.000 acetaldehyde, i.e., in its 0.0004 per cent. solution.* To distinguish still smaller amounts the solution had to be freed from oxygen. Bubbling of hydrogen has the disadvantage that it partly removes the volatile acetaldehyde. Therefore the removal of oxygen has been effected by the addition of lithium sulphite, which proved suitable in the polarographic estimation of acetaldehyde in its 10^{-5} m. solutions, *i.e.*, 0.00005 per cent. (see polarogram 2). The *sensitivity of this aldehyde test is thus 20 times greater than that of the colorimetric methods used.*



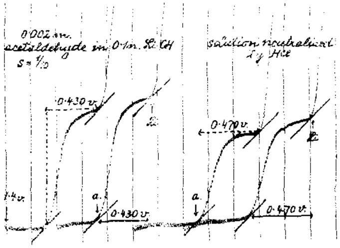
Polarogram 2.

Usually traces of acetaldehyde are estimated by the colorimetric method consisting in the rosy colouration produced by the addition of fuchsin decolourised by sulphurous acid (so called reagent of Schiff, Gayon, Villavecchio, etc.). However, the sensitivity of this test depends much on the composition of the reagent, which is difficult to standardise, and on the nature of solution in which the aldehyde is looked for. Sometimes the colouration appears even in absence of acetaldehyde, *e.g.*, in excess of alcohol. In aqueous solutions the most sensitive colorimetric agent reveals traces of 0.001 per cent. aldehyde.

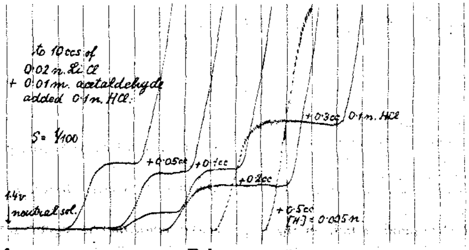


Polarogram 3.

The effect of acidity. It is remarkable that the electro-reduction of the aldehyde is shown only on curves due to neutral or alkaline solutions (see polarograms 2 and 3). The change of the concentration of hydroxyl ions produces no (see polarogram 4) noticeable shift in the reduction potential, where the potential is measured from the deposition potential of lithium; even if the solution is slightly acidified the reduction potential does not change. However, as the "wave" due to the deposition of hydrions increases, the "wave" due to the reduction of acetaldehyde gradually diminishes

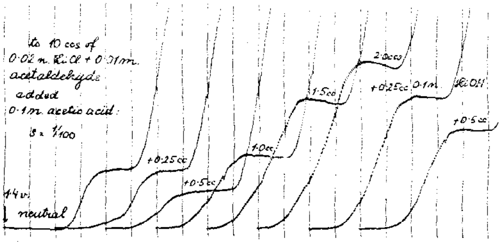


Polarogram 4.



Polarogram 5.

and disappears entirely when the concentration of hydrions exceeds the concentration of acetaldehyde (polarogram 5). The same disappearance of the aldehyde " wave " is noticeable when to a neutral or alkaline solution a weak acid, *e.g.*, acetic is added (polarogram 6); here, however, the distinction between the hydrogen and the aldehyde reduction " wave " is difficult, owing to the more negative deposition potential of hydrions from the weak acid. After neutralisation of the acidic solution the aldehyde " wave " appears again at the same potential as before acidulation. The probable cause of this evident hindrance of the electro-reduction in acidic medium will be discussed below.



Polarogram 6.

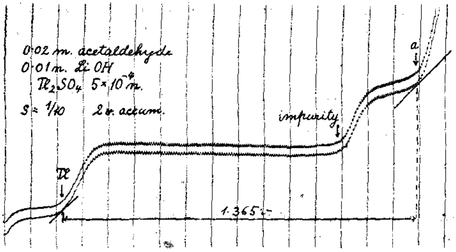
The behaviour already described shows clearly that the reduction does not proceed by means of primarily deposited hydrogen atoms and that it is not a reversible electrode process.

The determination of the reduction potential and of the mode of electro-reduction. To obtain an idea of the mechanism of the reduction electrode process, the shape of the current-voltage curves and their shifts due to the change of concentration were investigated. The reduction potentials were referred to the deposition potential of lithium or of thallium ions present in the same solution; some determinations were calculated from the potential of the calomel electrode, which was compared with the potential of the mercury anode in the electrolysing vessel.

First determination : Solution contained 5.10^{-4} n. Tl_2SO_4, 10^{-2} n. LiOH, $1.5.\ 10^{-3}$ m. acetaldehyde. The difference between the deposition potential of thallium and the reduction potential if aldehyde was −1.435 v.

Second determination : Solution was 5.10^{-4} n. Tl_2SO_4, 10^{-2} n. LiOH, $2.\ 10^{-2}$ m. acetaldehyde. The potential difference −1.365 v. was found. Thus the shift of the *reduction potential is 70 millivolts due to the change of concentrations from 1.5×10^{-3} to 20×10^{-3}. This means that for a ten-fold* concentration change the shift of potential would amount to

$$70/\log \frac{20}{1.5} = 62 \text{ millivolts.}$$



Polarogram 7.

Third determination: Solution 5.10^{-4} n. Tl_2SO_4, 10^{-2} n. LiOH, 1.1×10^{-3} m. acetaldehyde. The difference of potentials was -1.440 v. The reduction potential was shifted against that observed in the first solution by 75 millivolts. This gives for a ten-fold concentration change a shift of 60 millivolts, *i.e.*, that of a monovalent reduction.

Another three determinations gave again the figure of 60 millivolts for the shift due to a ten-fold concentration change.

Basing on these numbers we may not calculate the "molar reduction potential" *i.e.*, the cathodic potential at which the current-voltage curve shows the bend due to the reduction of acetaldehyde in its molar solution.

The deposition potential of thallium from its normal solution is -0.150 v. (from the normal calomel zero); this figure was derived from the current-voltage curve obtained with the full sensitivity of the galvanometer (10^{-8} amp./mm). Hence the deposition potential from a 5.10^{-4} n. Tl_2SO_4 solution occurs at -0.340 v., if full sensitivity of the galvanometer is used.

In the above measurements, however, only $^1/_{10}$ of the maximal sensitivity was used for polarographic curves. Hence in these the position of the thallium deposition bend must occur at -0.340 c. -0.057 v., i.e., -0.397 v. from the calomel zero.

It must be borne in mind that a diminution of sensitivity produces the same shift in the deposition potential as an equal diminution of concentration, since the position of the potential is determined by the 45° tangent point of the bend at the current-voltage curve.

Now the 10^{-2} m. acetaldehyde solution was found to be reduced at a potential by -1.385 v. more negative than that of 5.10^{-4} n. Tl_2SO_4, *i.e.*, -1.385 v. -0.397 v. $= -1.782$ v. However, from this figure the drop of potential across the solution has to be subtracted, which is $i = 50 \times 10^{-7}$ amp. and $R = 1.500$ ohm; this correction is 0.0075 v.

Hence in a 10^{-2} m. acetaldehyde solution the reduction potential occurs at -1.774 v., and thus in a molar solution at a potential by 0.114 v. more positive, *i.e.*, at -1.660 v. when observed with $^1/_{10}$ sensitivity of the galvanometer. The "molar reduction potential" for maximal sensitivity becomes thus -1.600 v. from the potential of the normal calomel electrode.

The deposition potential of lithium was also determined in the centinormal solutions and found to be -2.270 to -2.275 v. when $^1/_{10}$ of the sensitivity was used. Acetaldehyde when concentrated equally to lithium showed the reduction bend at a potential by 0.550 v. more positive. The *i.R* correction amounted to 0.045 v. Hence the reduction potential of centimolar acetaldehyde solution comes out to be -1.765 to -1.770 v., which agrees well with the figure -1.774 v. obtained from the difference observed from the deposition potential of thallium.

All polarographic recording has been made with $^1/_{10}$ of the full galvanometric sensitivity for the reason that impurities present in aldehyde and in compounds of lithium would, with larger sensitivities, make the bends of polarographic curves indistinct. Thus in solutions electrolysed open to the air a new "wave" rises 0.2 v. before the reduction bend of acetaldehyde (see polarogram 3) and is still more conspicuous when oxygen is removed by bubbling hydrogen through the solution. The nature of the substance, which causes this "wave" has not yet been investigated.

Next the process of electro-reduction has been investigated from the log i-π curve, where π denotes the cathodic potential, in order to find out how many equivalents of electricity are used per gram-molecule of acetaldehyde. For that reason the ordinates due to small changes in π were carefully measured and their logs plotted against π. It was hereby ascertained that $\pi = 0.060 \log i$ which means that 1 faraday is necessary to reduce one molecule of the aldehyde. Thus the relation holds $\pi = RT/F \log i$, which agrees well with the relation found above, *viz.*, $\pi = RT/F \log C_1/C_2$, from the shifts of the reduction potential with changes of concentration. This would suggest that the electrode process is, since direct charge $R + \ominus \rightarrow R'$ is in this case not imaginable, of the type

$$R + H \rightarrow RH \quad \text{or}$$
$$2R + 2H \rightarrow R_2H_2.$$

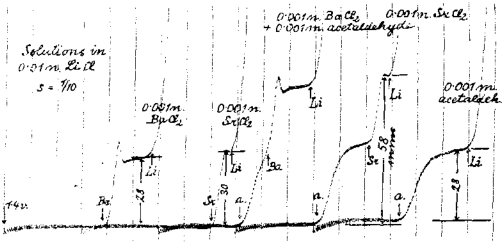
In such a reversible process the cathodic potential should depend on the hydrion concentration by the formula

$$\pi = \frac{RT}{F} \log \frac{[H^{\cdot}]_1 . C_1}{[H^{\cdot}]_2 . C_2}.$$

Thus a change of alkalinity from a 0.01 n. alkali to a neutral solution should effect a 0.3 v. shift in the reduction potential. Yet

the observable shift in such solutions is less than 0.03 v. The reversible reduction formula here obviously does not hold. We have, therefore, to regard this electro-reduction as an irreversible one. In such a case, however, the character of the bend of the current-voltage curves gives us no reliable information as to the number of faradays consumed per mol of acetaldehyde. Bearing in mind that the process is irreversible the above formulæ have to be regarded as meaningless. The only reliable indication of the electric equivalent of the electro-reduction may be obtained from the magnitude of the diffusion current, *i.e.*, height of the polarographic " wave " due to acetaldehyde.

The intensity of a diffusion current is given by the velocity of diffusion of the particle, which is reduced, and by the amount of electricity which it requires for reduction. If we now find a substance, which has the same diffusion coefficient as acetaldehyde and the number of equivalents involved in its electro-reduction is known, we may estimate the number of equivalents necessary for the reduction of acetaldehyde from the heights of the diffusion currents due to equivalent solutions.



Polarogram 8.

Polarogram 8 shows such diffusion currents " waves ") due to a solution of barium and strontium chloride in an equivalent concentration as the acetaldehyde admixed to them. The diffusion coefficient of barium chloride is 0.66 (in a 0.2 m. concentration, at 8° C) and is supposed to be near to the diffusion coefficient of acetaldehyde; the coefficient for the aldehyde has not been found (in Landolt Börnstein Tables, ed. 1911), but is given for compounds of practically the same volume, *e.g.*, ethylalcohol 0.69 (0.25 m. at 11° C.), acetic acid 0.66 (0.4 m. 8° C) and 0.76 (0.25 m. 12° C). The height of " waves " due to a 0.001 n. solution of barium or strontium chloride is equal to the height of the 0.001 m. acetaldehyde. The deposition potential of barium is, moreover, very close to the reduction potential of acetaldehyde, which means that the rate of dropping and size of drops are practically equal. We may therefore conclude that the amount of electricity necessary for the reduction of one gram-molecule of acetaldehyde is equal to that necessary to deposit one equivalent of barium, *i.e.*, 1 faraday.

We cannot, however, imagine a reduction of an aldehydic group effected by one equivalent of electricity or one atom of hydrogen. At least double these quantities have to be considered, *e.g.*, in the reduction :

$$2CH_3COH + 2\ominus + H_2O \longrightarrow \begin{array}{l} CH_3CHOH \\ \quad | \qquad\quad +O'' \\ CH_3CHOH \end{array}$$

which would yield di-methyl-glycol.

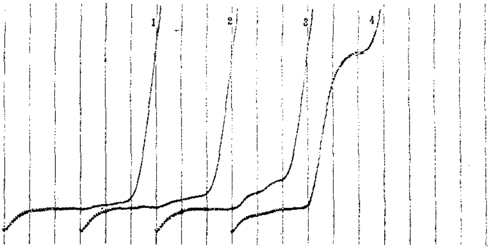
The proposed reaction is analogous to the electro-reduction of two molecules of acetone to pinacone; it would be favoured by condensation of acetaldehyde, which is known to proceed more readily in alkaline solutions; indeed the reduction of acetaldehyde takes place in an alkaline or neutral solution and is hampered by acidity.

It remains to explain why the current-voltage curves due to an irreversible electrode process show the same shape of bend and shifts of the reduction potentials, when the concentration of acetaldehyde is varied, as those due to a reversible process. The irreversibility, as has been pointed out above, is derived from the fact that the reduction potential is insensitive to concentration changes of hydrions or hydroxyl ions.

In such a case the kinetic theory of irreversible reduction as worked out recently by W. Kemula[3] may be adopted; according to this the intensity of current is given by the rate of reduction of molecules activated in the cathodic interface. In this way it may be shown that the "reversible" shape of a current-voltage curve also appears in processes of electro-reduction, in which a reversible electrode process is evidently not maintained.

Whilst M. Shikata applied the polarographic quantitative estimation of acetaldehyde for beverages, the present author determined the amount of aldehyde in the fermentation products ethylalcohol and acetic acid.

The determination of acetaldehyde in ethylalcohol. The spirit has to be diluted with 9 volumes of water and one tenth of this mixture allowed to distil over; in this portion practically all aldehyde is present. Lithium chloride is added to the distillate and the solution is electrolysed open to the the air. Polarogram 9 shows curves obtained from distillates of four various sorts of ethylalcohol. The curves of tbe "finest spirit" shows hardly any reduction "wave," whilst the sort denoted "fine" shows a 0.0005 per cent. contamination of aldehyde. The "medium" specimen shows two aldehydes of ca 0.001 per cent. each, whilst the "crude" spirit shows polarographically a content of 0.01 per cent.

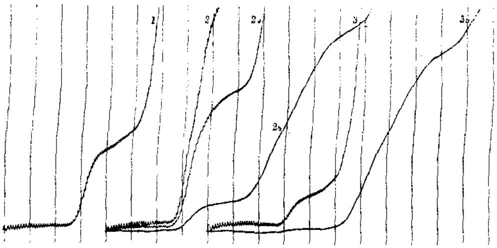


Polarogram 9.

Traces of acetaldehyde in distillates from 10 per cent. of spirits: 1 finest, 2 fine, 3 medium, 4 crude rectified spirit.

The investigation of vinegar. This research has been carried out under the guidance of Mr. J. Stastny[4], director of the Spirit Research Institute, to whom the author's best thanks are due.

To carry out the analysis the vinegar sample was neutralised by ca 2n. lithium hydroxide and one fifth of the solution distilled off. To the distillate a concentrated solution of lithium chloride was added to make the distillate 0.01 n LiCl.



Polarogram 10.

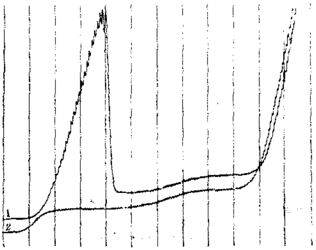
Distillates of 10 per cent. vinegars, neutralised by LiOH. Presence *of acetaldehyde in :*

1. and 2. vinegar fermented from spirit.
3. vinegar mixed from synthetic and fermented acid.
1., 2., 3. with $^1/_{10}$; 2*a*, with $^1/_{20}$; 2*b*, 3*b*, with $^1/_{100}$ sensitivity.

In this manner in all vinegars obtained from fermentation of alcohol always an *almost constant amount of acetaldehyde* was ascertained, ca 0.001 to 0.002 per cent. In vinegars fermented from wine the content was greater, ca. 0.01 per cent. In vinegars prepared from synthetic or pyrolignic acetic acid not a trace of aldehyde has been found. Another very conspicuous difference has been observed between natural, *i.e.*, fermented vinegars and those *prepared from synthetic or pyrolignic acetic* acid.

Whilst the latter acetic acid solution produces no suppressing effect upon the maxima *on current-voltage curves, the fermented* vinegars exhibit a very prominent suppressive activity.

Polarogram 11 shows this different behaviour.



Polarogram 11.

0.01 n NaOH containing :

1. *0.025 molar wood-vinegar,*
2. *0.025 molar fermentation vinegar.*

Here the substance, to the reduction of which the maximum of current is due, is atmospheric oxygen dissolved in the solu*tion. Owing to traces of highly adsorbable* fermentation products present in the natural vinegar, the "adsorption maximum" of oxygen is entirely suppressed even in considerably diluted solutions.

Thus when a natural vinegar is diluted to 0.025 m. in 0.01 m. LiOH, the maximum due to the presence of oxygen is suppressed entirely, whilst pyrolignic acid in the same *concentration produces no noticeable effect on the shape of the maximum.*

The author expresses his thanks to Professor J. Heyrovsky for his suggestions and help.

Summary.

The electro-reduction of acetaldehyde proceeding at the dropping mercury cathode has been investigated by means of current voltage curves registered polarographically.

It has been found that

1. Acetaldehyde is reduced at a cathodic potential, which is by 0.50 v. more positive than the potentials at which lithium de-

posits from solutions equally concentrated as the acetaldehyde. Thus the "molar reduction potential" of acetaldehyde is −1.60 v.;

2. The value of the "reduction potential" is not influenced by changes from neutrality to a weakly acidic or strongly alkaline solution;

3. Increasing acidity of the solution hinders the electro-reduction of acetaldehyde;

4. A change of the concentration, c, of acetaldehyde produces a shift of the reduction potential π according to the fodmula $\pi = 0.060 \log c$ volt; mathematical analysis of the bend of the current-voltage curve shows that $\pi = -0.060 \log i$, *i.e.*, $-RT/F \log i$;

5. The height of the diffusion current indicates that the electro-reduction of one gram-molecule of acetaldehyde requires one faraday of electricity, the probable reduction product being di-methylglycol;

6. The limit of estimation of acetaldehyde is 0.00005 per cent., *i.e.*, 1 part per 2,000.000; 1 cc. of solution suffices, containing at least 0.0005 milligram of acetaldehyde. The precision of the quantitative estimation is 10 per cent., if least traces are not considered.

7. In fermented vinegars 0.001 to 0.002 per cent. acetaldehyde were estimated polarographically, whilst in synthetic or pyrolignic vinegars no traces of acetaldehyde were found.

Solutions of fermented vinegars greatly suppress maxima on current-voltage curves, synthetic or pyrolignic acetic acid produces no such effect.

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[3] W. Kemula: *Collection of Czechoslovak Chemical Communications*, 1930, 2, 502.

[4] J. Heyrovsky—I. Smoler—J. Stastny: *Vestnik cs. akad. zemedelske* (*Bulletin of the Czechoslovak Academy of Agriculture*), 1930, 6, 490.

[5] J. Rasch: *Collection of Czechoslovak Chemical Communications*, 1929, 1, 560; E. Varasova: *ibid*, 1930, 2, 8.

THE INFLUENCE OF PHYSICAL RESEARCH ON THE DEVELOPMENT OF WIRELESS.

By W. H. Eccles, D.Sc., F.R.S., F.Inst.P.

(*Presidential Address given before the Institute of Physics.*)

(*Continued from page 85.*)

By 1910 von Lieben had turned his attention to the use of a grid for accelerating electrons till they produce ionisation by collision just beyond the grid in the space between the grid and the anode, and does not appear to have recognised the probable indentity of his tube and de Forest's. In 1911 and 1912 the "soft" triode run its short life, a brilliant and useful life in Germany and England—a life that may some day be renewed. The key to the situation was really lying all the time in Varley's remark, already quoted from his 1903 paper, that electrons did not pass through the grid in quantity until the vacuum was below five microns. However, during these years the physical laboratories intent upon the study of electricity at extreme exhaustions developed several methods of producing and retaining very high vacua. In the years 1912 and 1913 Langmuir, working in the laboratory which also evolved the Coolidge X-ray tube, gave the trode a more stable behaviour by resorting to extreme rarefaction. In France the physicists drafted into the military laboratories soon after the war began, also introduced high vacuum technique and improved the structure of the triode. Thus, very gradually, between 1907 and 1913, was brought to its maturity the instrument destined to effect the greatest revolution yet recorded in the history of wireless engineering.

The technical value of the high vacuum triode rests upon its ability to magnify very small and very rapid electrical changes with fidelity. An electromotive force applied to the grid causes inappreciable current flow, but liberates a magnified electromotive force in the anode circuit where relatively large currents are possible—consequently the input energy is minute and the corresponding output energy is relatively enormous. When such an amplifier was handed over to the scientific engineers, the cascade arrangements and back-coupled circuits already designed for soft triodes, and familiar some years earlier in connection with the microphone-telephone amplifier, were quickly elaborated. The facility of

adjustment of the frequency of triodic oscillators made the heterodyne method of receiving C.W. signals very easy and sensitive, and thus the heterodyne method into prominence and, in fact, predominance; and almost simultaneously the development in size of triodic oscillation generators made them feasible for the transmission of C.W. signals and telephony.

After this last revolution in wireless technique, later developments in the apparatus and methods of radio communication seem relatively undramatic. There have been consequential vast reorganisations of plant and plans, but these belong to the history of engineering. Leaving these aside, though they are indeed eloquent examples of the influence of physical research, let us consider a few of the developments, falling within this triodic age, which have been initiated by physicists and widely used on a large scale of practice, ignorging for this purpose the immense number of developments of narrower application. Many of these developments came about because the war pressed numerous physicists into wireless in all the belligerent countries, and caused a voluminous outponring of physical knowledge into the solution of definite and urgent practical problems. For my present purpose I select two examples, with which I am very familiar, of the influence of the physical laboratory. These are two methods of generating electrical oscillatious for transmitting stations which were designed as alternatives to the back-coupled valve method when it threatened to become a severe monopoly. The first is the crossed valve method, which was devised in the physical research laboratories of Finsbury Technical College in 1916-17 at the request of the Signals Experimental Establishment of our War Office. It was intended for use over short distances behind the trenches on wave-lengths of 50 metres and less. It has since been used in innumerable short-wave stations.

The second method aims at generating electrical oscillations of very constant frequency by the aid of massive bodies sustained in mechanical vibration by triodes. The first apparatus of this kind was the tuning fork alternator, which was designed early in 1917 for delivering fundamental and harmonic frequencies for the purpose of measurements in the physical laboratory. A later apparatus arose out of the growth of supersonic under-water signalling in 1917. In the autumn of that year Langevin in France and Rutherford in England independently suggested that piezo-electric qualities of quartz might be utilised for perceiving the arrival at a receiving sation of pressure waves in water, and for producing such waves at a transmitting station. In 1918 Langevin's work at Toulon was supplemented by his collaborators at Finsbury Technical College and Harwich, and at Finsbury this led, first, to an appreciation of the fact that quartz vibrating under the stimulus of a feed-back circuit steadied the electrical oscillator, and, later, to a triode circuit for automatically sustaining quartz in vibration at its natural frequency in water without the use of back coupling. At about the same time, we learned later, Nicolson, in the New York laboratory of the Western Electric Company, devised an equivalent method of vibrating piezo-electric crystals such as Rochelle salt in air by aid of a triode. A year or two later the American physicists Cady and Pierce revived the subject and brought vibrating quartz prominently to the notice of wireless engineers. Thus came about what may be called the marriage of mechanical and electrical oscillations, the so-called "stabilisation of frequency," which plays so large a part to-day in wireless stations, large and small.

I might prolong this review by discussing poly-electrode valves, photo-electric cells, directional arrays and upward radiation, applications of magneto-striction, and other examples of the direct contributions by physicists to wireless in its various ramifications. I might also call attention to the work of physicists in helping the engineer to his successes. For iustance, the development of high-frequency alternators in America, Germany and France, and the design and construction of the beam stations in this country, to mention only two fine engineering triumphs, owe something to the physicist. The physicist has also provided all the explanations yet offered of the obstructive natural phenomena which have, from time to time, confronted the engineer. In fact the studv of the electrical properties of the atmosphere by aid of wireless waves has become a branch of geophysics. Conversely, an enormous mass of knowledge has been acquired concerning the effect of the electrical state of the atmosphere on the propagation of wireless waves, natural and artificial, and this has already assisted the practical operation of telegraphic circuits; in this country the study has been

pursued under the auspicess of the Radio Research Board and also by T. L. Eckersley.

Much of the fertile research just alluded to arose from a chance discovery which ought to have been, and nearly was, prophesied definitely by physical theory—the discovery that short waves could travel long distances. Short-wave transmitting and receiving apparatus was much used during the war, for instance 50 metres for trench sets and under 20 metres for aeroplanes, in several of the belligerent countries; and by 1921 short waves had been tried for telephony across a hundred miles of the North Sea and between London and Birmingham overland; but even late in 1922 no one suspected that short waves can shoot aloft and come down ten thousand miles away. Perhaps experiments made within the skip distance were bound to be misleading. Indeed, in 1922 the commercial wireless organisations appear to have convinced themselves that the future use of short waves lay in the navigation of ships very near to each other or close to land in foggy weather.

However, before 1920 all the gear for generating and receiving short waves, for amplifying and detecting them, both with and without directional aerials, was well known in every country. Parabolic and other reflectors had been repeatedly invented, some of them years before the war, and the properties of short waves on wires had been so thoroughly investigated that nothing new had been added for many years. In fact all the technique of short-wave telegraphy and telephony was complete and waiting for someone in possession of the apparatus to put one set here and another set five thousand miles away, and listen-in. Now it chanced that, after the war, amateur wireless enthusiasts were officially relegated in most countries to try their transmission experiments with waves shorter than 300 metres. Gradually, widely scattered amateurs began to overhear signals exchanged between very distant pairs of colleagues. In 1921, besides, American amateurs transmittted to British amateurs on wave-lengths of about 200 metres, and this was reciprocated in 1922.

So far as I can trace in the literature it was not until September 1923 that the first commercial long-distance message was transmitted—it was sent from New York to Buenos Aires. Early in 1924 Pittsburgh sent a programme to London on 98 metres for re-broadcasting by that station. In England the first regular commercial service was that of the Post Office in the spring of 1925. The first English beam station was put into commercial operation in 1926. The reason for the slowness of adoption of short waves was the view that they could give only partial service, mainly during the dark hours, whereas long waves gave a more complete service. But in 1925 empirical testing was supplemented by scientific investigators, and it was discovered that waves under 25 metres in length travelled great distances in daylight —a discovery which at once doubled the discovery so stimulated the adoption of short waves that their employment is now utility of short-wave stations. This new universal. A remarkable feature of this turn over to short-wave working is that it was accomplished without immediately causing disastrous losses of plant and material—it was a bloodless revolution because it did not diminish the value of the services rendered by existing stations and because it came slowly. It has already led to a greater volume of geophysical research and an improved knowledge of the atmosphere; and this, has influenced, and is still influencing, practice.

My analysis has proceeded by picking out those applications of physics to wireless which have rendered universal service; the alternative method of analysis would be to write down a complete list of the principal stages of progress and to select those attributable to the physical research laboratory. I think I may claim to have shown that wireless has progressed to its present position by a series of jumps; that each jump, including that which started it, has been due to the injection of a new physical principle or process by physicists; and in the intervals between jumps the engineers have done the indispensable work of making new designs and erecting practical plant. Some of the jumps, for example the maturing of the triode, have led to the scrapping of equipment before it has earned the cost of its engineering development; but the same event created in compensation the entirely new industry of popular broadcasting.

I can imagine that industrialists fear these revolutionary steps, so I will ask them to look back at a similar period and the manner of dealing with it. Fifty or sixty years ago, Britain, thanks to its coal, iron, easy transport and mechanical in-

stincts, could claim to be the workshop of the world. In industry there were certainly no physicists, and very few scientific engineers. Rule of thumb was the general practice, hit-and-miss the guiding principle. It was the day of the practical man, and the slogan ran : " an ounce of practice is worth a ton of theory." But scientific engineers gradually emerged and pressed their revolutionary improvements into the factories. To-day all is changed; the scientific engineer has an acknowledged place, calculation has ousted hit-and-miss and an ounce of paper saves tons of steel, ordered and accurate measurements foreshadow full scale results and avoid wasteful trial and error. *And now, again, a new epoch is dawning—physical science is penetrating into industry just as scientific engineering did a generation ago.* To meet the situation some of our industrialists are asking men trained in engineering to adventure into physical research. I believe this is not the best policy, and that it is the duty of this Institute to convince employers that the enlistment of a due proportion of physicists would pay. This is the time for the Institute to begin its efforts, for at the present moment the industrial community in this country is undertaking a strict self examination. There is much discussion of the process called rationalisation which was brought into prominence in 1927 by the World Economic Conference in Geneva. *Has the physicist a place in this movement?*

The main object of rationalisation is to reduce the costs of production and eliminate waste in basic industries. On the technical side, an important instrument of rationalisation is standardisation (which takes two forms), and another is the modernisation of plant and products by the introduction of the latest invention and knowledge. The *form of standardisation that asks all manufacturers of certain articles to work to agreed specifications is the concern of the engineer;* the form that calls a halt in the introduction of innovations affects also the physicist, and is in conflict with the principle of modernisation. The conflict has, so far as I know, not yet been thoroughly discussed. To put the matter another way; it is not economic to standardise machinery or products too soon, that is before the latest improvements have been incorporated, and, on the other hand, it is *not economic to modify a standardised form until the costs of adopting it have been recovered.* This conflict is well illustrated in the history of wireless, and unceasingly appears in many other industries, such as the heavy electrical industry. To those responsible for making decisions it is no easy task to settle when to introduce improvements and when to stop improving in order to standardise. They probably regard the phycist as the villain of the piece; for in certain industries he has been the cause of many a sudden change of direction, the source of many a revolutionary idea. But the better view of the position of the phycist in this matter is that he *possesses potentialities for helping, as well as for disturbing, the stability desirable even in progressive motion; for as he lives in the laboratories whence spring the sort of invention that overturns the established order, he is better equipped than others to* forecast in some degree the direction of forthcoming change, and to assist in deciding when to standardise and when to modernise.

A POSSIBLE TRANSITION FROM INORGANIC TO ORGANISED MATTER.

A Correction.

In the article under the above heading on January 16 by Maurice Copisarow, D.Sc. a line was inadvertently omitted from the third paragraph, col. 2, P. 38. The lines should read, " all available evidence appears to converge in indicating the arboreal effusions, already referred to under opacity bands, to the prime agents in the first stage of organic synthesis."

FARADAY MEDAL AWARD.

The Council of the Institution of Electrical Engineers have made the tenth award of the Faraday Medal to Mr. Charles H. Merz., M.I.E.E.

The Faraday Medal is awarded by the Council of the Institution not more frequently than once a year either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science without restriction as regards nationality, country of residence, or membership of the Institution.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

February 5, 1931.

The following papers were read—

The Pressure Exerted by Granular Material. By C. F. JENKIN. Communicated by Sir Alfred Ewing, F.R.S.

Two striking experiments on sand are described which led to the recognition of Dilatancy as the most important factor in the behaviour of granular material and the true foundation for a theory of Earth Pressures—a fact prophesied 45 years ago by Osborne Reynolds. The paper describes the steps by which the principles of Dilatancy have been used to elucidate the problems of Earth Pressure.

Starting with spherical grains the problem of intergranular forces in three dimensions was found too difficult, and it was reduced to a two dimensional problem. A model consisting of a rectangular frame holding a single layer of steel discs was made which is shown to reproduce the leading phenomena observed in sand, particularly the remarkable effects of "Arching." The solutions are found for the forces exerted by the discs under a number of different conditions, including three typical examples of Arching.

In the light of these results an apparatus was designed for measuring the pressure of sand on a retaining wall in which *end arching* was eliminated, thus avoiding the causes of error in former tests. This gives reliable results, some of which are given in five tables. They entirely confirm the new principles and show that serious errors may result from the use of old theories. The most important new result, confirmed by the experiments, is that the centre of pressure may be very much higher than was supposed and that the pressure distribution on the wall is quite different from the triangular distribution commonly assumed—a result of importance to engineers. Recent empirical engineering formulæ used in Germany show that this fact is already suspected.

The effects of grain shape and intergranular friction are discussed and experiments with the new apparatus on glass spheres and ground glass are described and compared with those on sand. Also experiments on the initial forces exerted before a regular regime is established; and experiments on the effect of vibration. Tests on vertical walls with different amounts of surcharge and on inclined walls are given. Walls with both rough and smooth surfaces were tested.

The Diffraction of Electrons in Mercury Vapour. By F. L. ARNOT. Communicated by Lord Rutherford, F.R.S.

An investigation of the angular scattering of electrons in mercury vapour over an angular range of from 18° to 126° is described. Results are shown for fifteen different velocities of the primary beam between 8 and 800 volts. All the scattering curves show distinct maxima and minima, maxima of four different orders being obtained.

An estimate of the absolute scattering is given.

The absolute scattering of 82 volt electrons between 15° and 60° has been re-determined, and the results are in good agreement with the author's earlier work between this range. The work is at present being continued with other gases.

On the Transmission of Light by Thin Films of Metal. By S. RAMA SWAMY. Communicated by W. Wilson, F.R.S.

Purely qualitative observations of the colour changes on heating thin films of metals have been made by Faraday, Beilby, R. W. Wood and others. In this paper quantitative observations on the transmission coefficient of metal films for different wavelengths of light in the visible range and its changes on heating the films are described and discussed. Gold and silver were the metals examined, thin films of these being obtained by cathodic sputtering. The films were heated in a furnace and their absorption spectra photographed at different temperatures, a pointolite lamp being the source of light. The transmission coefficient was deduced from the photometric measurements of the spectrograms. The results obtained were found to agree in some respects, but not in all, with those calculated according to Maxwell Garnett's theory.

The following papers were read in title only :—

The Diurnal Tide in an Ocean Bounded by Two Meridians. By D. C. COLBOURNE. Communicated by G. R. Goldsbrough, F.R.S.

The diurnal tide is considered in an ocean on a rotating globe bounded by two meridians 60° apart and of uniform depth 12,700 feet. The solution of the general dynamical

equations of the tides satisfying the required conditions is obtained gy the introduction of a null function according to the method developed by Goldsbrough.

By means of this solution the tidal amplitudes and phase angles at numerous points have been calculated. The results show that the amplitudes of the diurnal tide are considerably smaller than those of the semi-diurnal tide and that the range of values obtained for the phase is unusually limited. The latter characteristic is shown to be due to the fact that the wave represented by the solution is equivalent to the combination of a progressive wave and a stationary wave of much larger amplitude. There are therefore two periods during which neither high nor low water occurs at any point of the ocean as far as the diurnal tide is concerned.

The Forces on a Solid Body Moving through Viscous Fluid. By S. GOLDSTEIN. (With notes by J. M. Burgers). Communicated by H. Jeffreys, F.R.S.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

JANUARY EXAMINATION, 1931.—PASS LIST.

Examination in General Chemistry for the Associateship.

Boundy, Cifford Kenneth (Central Technical School, Liverpool; and College of Technology, Manchester); Clark, George Charles Harry (West Ham Municipal College); Edwards, Aubrey Harris (Trained under S. R. Illingworth, D.Sc., F.I.C.); France, Horace Vernon (Technical College, Huddersfield); Gresham, Harold Ernest, B.Sc. (Lond.) (Technical College, Derby); Jasperson, Harold, B.Sc. (Lond.). (Central Technical School, Liverpool); Jones, Frederick Arthur, B.Sc. (Lond.) (Technical College, Birmingham; Keelty, Joseph Vincent (Technical College, Leeds); Purser, Ernest Granville, B.Sc. (Lond.) (Battersea Polytechnic; and Chelsea Polytechnic, London-; Radley, Jack Augustus, B.Sc. (Lond.) (Trained under R. P. Page, F.I.C.); Rampton, Harry Cecil, B.Sc. (Lond.) (Chelsea Polytechnic, London); Watts, John Thomas, B.Sc. (Lond.) (Loughhorough College, Leicester): White, Bertram, B.Sc. (Lond.) (Technical College, Birmingham); Woodhall, William, B.Sc. (Lond.) (Wigan and District Mining and Technical College; and Sir John Cass Technical Institute, London).

NOTICES OF BOOKS.

Verdampfen Kondensieren und Kühlen by E. HAUSBRAND. Seventh edition revised by ENG. DIP. M. HIRSCH. Pp. XVI + 360. Berlin: Julius Springer. 1931. Price 29 marks.

This standard work on the physical and technical aspects of evaporation, condensation and cooling has just been revised by a specialist in chemical engineering who has added much new information concerning the construction of boilers, coolers and plant generally. There is also an account of the features and points to be taken into consideration in connection with the erection of plant on given sites and for ships.

Whilst the authors have drawn upon descriptious given in the technical literature they have preferred to describe the specialities of as many manufacturers as possible. Actually the designs and products of over fifty of the leading German, Continental, English and American firms are given in detail.

The theoretical side of the subject of evaporation and condensation has not been neglected and the mathematical treatment of the subject is also good.

Selbstätige Filtrationsapparate by PROF. J. V. DUBSKY. Pp. 64. Leigzig: Georg Thieme. 1931. Price 3 marks.

In this interesting monograph, Prof. Dubsky, who is Director of the Analytical Chemistry Laboratory at the Masaryk University of Brno, has collected and described the many devices that have been used for automatic filtration. He begins with the earliest reference to the subject contained in a letter from Haüy addressed to Berzelius in 1831 and altogether refers to seventy communications, forty-three of which are illustrated in his monograph. The first time that automatic filtration is mentioned in *The Chemical News* is in 1868 when Prof. Brady described a method for continuously washing a precipitate and since then there have been numerous attempts to devise a really efficient means of attaining this end.

In 1928, Dubsky and Rabas constructed an apparatus consisting of a type of automatic dropping funnel (without tap) dipping into the filtering funnel and capable of regulation and adjustment. Both the apparatus and the monograph can be commended to the attention of Analytical Chemists.

Forthcoming Events.

ROYAL INSTITUTION.

21, Albermarle Street, W.1.

Saturday, 14 February, at 8 p.m.—" On Speaking Verse." By James Stephens.

Tuesday, 17 February, at 5.15 p.m.— " The Sizes of Atoms." By Sir William Bragg, K.B.E., M.A., D.Sc., F.R.S., M.R.I.

Thursday, 19 February, at 5.15 p.m.— " Respiration." By J. B. S. Haldane.

Friday, 20 February, at 9 p.m.—" Prehistory and Genetics." By J. B. S. Haldone.

THE INSTITUTE OF METALS.

SHEFFIELD LOCAL SECTION.

Monday, February 16, at 7.30 p.m., in the Non-Ferrous Section of the Applied Science Department of the University, St. Georges Square. Conjoint Meeting for a discussion on Refractories for Heating and Melting Furnaces.

SOCIETY OF DYERS AND COLOURISTS.

MANCHESTER SECTION.

The Sixth Meeting of the Session will be held on Friday, February 20, 1931, at 7 p.m., in the Lecture Room of the Manchester Literary and Philosophical Society, 36, George Street, Manchester.

The following paper will be read :—

" Solazol Dyestuffs." By J. S. Wilson, Esq., M.Sc.

Members are reminded that they will have an opportunity of reading short papers on April 17, and are asked to give notice of such papers to the Hon. Sec.

THE PHYSICAL SOCIETY.

Friday, February 20, at 5 p.m. at the Imperial College of Science, Imperial Institute Road, South Kensington. Ordinary Meeting.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Wednesday, February 18, at 8 p.m.— Ordinary Meeting. " The Art of the Bridge Builder." By Gavin Heynes Jack, M.Inst. C.E., F.S.A., F.R.I.B.A., County Surveyor of Herefordshire. E. Guy Dawber, A.R.A., F.S.A., F.R.I.B.A., Past-President, Royal Institute of British Architects, will preside.

ROYAL INSTITUTE OF PUBLIC HEALTH.

The Annual Congress of the Institute, 1931.

The next Congree will be held in the City of Frankfurt, during Whitsuntide, 1931, on invitation of the German Government, the Oberburgermeister of Frankfurt, and the University of that City, and under the Presidency of the Most Hon. The Marquess of Reading, G.C.B., G.C.S.I., G.C.I.E., G.C.V.O. Further particulars can be obtained at the Institute, 7, Russel Square, London, W.C.1.

UNIVERSITY OF LONDON.

University College.

Thursday, February 19, at 5.30 p.m.— " America since the World War." First of a course of eight Public Lectures by Professor David S. Muzzey, Ph.D., of Columbia University, February 19, 23, 26, March 2, 5, 8, 12, and 16.

ROYAL MICROSCOPICAL SOCIETY.

B.M.A. House, Tavistock Square, W.C.1.

Wednesday, February 18, at 5.30 p.m.— An Ordinary Meeting of the Society will be held in the Hastings Hall at the above address. Dr. Robert Chambers, Professor of Biology, Washington Square College, University of New York, will deliver a communication on " The Nature of the Living Cell." With demonstration by Micro-dissection, Micro-injection, and Cinematograph.

The Biological Section will meet in the Pillar Room on Wednesday, March 4, 1931.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

2,049.—I. G. Farbenindustrie Akt.-Ges. — Destructive hydrogenation of carbonaceous materials. Januaryy 21.

2,091.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of nitrogenous vat dyestuffs. January 21.

2,187.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of acetylene. January 22.

Specifications Published.

341,405.—I. G. Farbenindustrie Ake.-Ges. —Process for the manufacture of easily soluble sodium salts of acylamino-phenol-arsinic acids.

341,781.—Consortium Fur Elektro-Chemische Industrie Ges.—Manufacture of 1 : 1 : 2-trichlorenthane.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

CONTOS.

517,343.—Chemical substances used for agricultural, horticultural and sanitary purposes.—Morris and Co. (Chester) Ltd., 135, Foregate Street, Chester. January 28.

ABRACOL.

517,528.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—A. Boake, Roberts and Co., Ltd., 100, Carpenters Road, Stratford, London, E.15. January 28. (Associated) (By Consent).

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or How to Reason Correctly. By J. E. Roscoe, M.A., Oxon.

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By the Rev. J. E. Roscoe, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

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THE CHEMICAL NEWS

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BOOKS FOR SALE.

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ELECTROLYTIC PRODUCTION OF HYDROXIDES AND HYDROGEN.

By R. SAXON, B.Sc., F.C.S.
Mem. Soc. Chem. Ind.,
Mem. Amer. Chem. Soc.

COPPER.

We are concerned with the electrolysis of water only, not of water with a drop of acid to "conduct the current."

Anode, Copper coil.
Cathode, carbon pencil.
Voltage, 240.
Resistance, 65 ohms.
Electrolyte, pure water.

As soon as the current is turned on hydrogen gas rushes from the cathode to fill the boiling tube placed over it, and the following takes place:—

1. Liquid turns faint apple green.
2. Bright green flakes float on top of liquid in cathode tube, before they appear anywhede else; no gas from anode.
3. Green flaky output from anode, spreads out like veils.
4. Liquid deeper green.
5. Green flakes on surface everywhere, but the *decided tendency is for this green to be attracted towards the anode.*
6. Blue green flakes under the green in cathode tube, which become almost pure blue, liquid becomes bluer.
7. White jelly-like tiny flakes appear.
8. Copper begins to be deposited, floating on the surface of a liquid blue or purple according to length of time run.

It is patent that the nascent hydrogen reduced the copper hydroxide, first to the monhydroxide and then to copper. This represents the reactions—

1. Current off,) HOH / HOH / Cu(
2. Current on, HH) (OH).Cu (
3. Reduction Cu(OH)./H = CuOH / HOH
4. Reduction CuOH / H = Cu / HOH.

It is to be noted that this reduction slows the rate of gas delivery, which is always noted, the initial rush being the fiercest. Neither bubbles nor gas above liquid in the cathode boiling tube will affect any reduction. The hydrogen which does so never appears as bubbles, but acts before such form.

COPPER AND U-TUBE.

We may use a U-tube with the above water, copper, and carbon, using a septum at the bottom of white glue and sand, standing the whole in a cooling bath. The same current density may be used as before. The action is very slow, and the green hydroxide

collects in spite of its natural tendency to float, at the bottom of the anode tube, gradually pushing its way into the colloid septum. The cathode tube liquid remains colourless. The *green hydroxide* never *shows any tendency to rise in the* anode tube, and is apparently *electro-positive*. It is decidedly repelled by the anode.

IRON AND U-TUBE.

We may repeat the experiment using iron coil and the others as before. Whether we use pure water, or the water already acted *on by the copper*, the hydroxide formed has not the same tendency to push through the septum, but the anode water takes on the usual amber colour. Whether it replaces the green liquid from the copper is not certain. The base of the anode tube is green, and the green hydroxide from the copper pushes further towards the cathods. This green is hydroxide of copper, and later iron. Red brown flakes of the ferric hydroxide fleck the liquid in the anode tube.

In any of these experiments there is no appreciable alteration to the liquid in the cathode tube.

RESISTANCE OF NICKEL AND NICKEL ALLOYS TO DRY SALTS.

In order to determine more closely the types of metallic materials suitable for the storage and transport of dry salts, experiments have been made on the behaviour of a range of metals and alloys in contact with magnesium chloride, potassium chloride, Hartsalz (a complex compound containing potassium chloride, rock salt and magnesium sulphate), sodium chloride, magnesium sulphate and carnallite (KCl, $MgCl_2$). The materials submitted to test comprised samples of nickel, nickel-copper alloy (67/28 and 33/67 per cent.), nickel-chromium-iron alloys (nickel 58-64, chromium 15, iron 14-20 per cent.) with and without small additions of tungsten and cobalt, nickel-chromium steel (nickel 7, chromium 20 per cent.), mild steel, aluminium and an aluminium alloy.

Conditions in the two series of tests, which were in each case of one year's duration, were as under :—

(1) A layer of dry salts, to a depth of 1-2 cm., was strewn on the samples, which were placed in separate compartments in a large container. In each compartment was a vessel of water to ensure saturation of the air.

(2) Samples strewn with salts as in (1) were placed, about 10 ft. from the ground level, in a room in which the window was kept constantly open, thus ensuring a natural atmospheric degree of moisture.

The samples were examined with regard to the nature of the attack (general or local), appearance of the surface and character of the corrosion product. The conclusions, although to some extent restricted by the condition of the samples, enable useful deductions to be drawn in respect of the probable comparative value of the materials in practical service : the variation in effect under the two conditions of test is negligible. The degree of attack shows a close relationship with the hygroscopicity of the salts, and the nature of the attack, *viz.*, pitting, general corrosion, etc., varies considerably from one material to another. In general, severity of attack decreases in the following order :—magnesium chloride, carnallite, Hartsalz (see above), potassium chloride, sodium chloride, magnesium sulphate.

Extensive tabular and photographic data are presented on the individual materials, and their behaviour is discussed in detail.

(E. Maass and W. Weiderholt.—" Testing of the Resistance of Metals and Alloys to Salt Solutions. II. The Action of Dry Salts on Metals and Alloys." *Korrosion und Metallschutz*, Nov., 1930, pp. 241-250.

THE WAGE FACTOR IN THE CANADIAN CHEMICAL INDUSTRIES.*

By LAWRENCE W. BASS.

Executive Assistant, Mellon Institute.

During the last few decades, management has been moving toward the status of a science. In common with the history of other sciences, its development must involve a change from the qualitative to the quantitative basis. For this transition there are required, not only dependable data concerning the industries, but also methods of interpreting this material. Operating ratios —such, for example, as those based on the *kilo man-hour*—appear destined to play an important part in this development.

In dealing with census statistics it should be borne in mind that, because of the composite nature of the numerical values, great caution must always be used in drawing conclusions.

* Abstracted from *Canadian Chemistry and Metallurgy*, Vol xiv, No. 12, December, 1930.

The ratio of wages to value added by manufacture is an important procedure for measuring the productivity of labour from the financial angle, because it is a relatively simple method of expressing a definite aspect of the wage factor in any specific industry. The significance of this ratio has been pointed out also (*The Canada Year Book*, 1929, p. 446): "An interesting inquiry is that regarding the relation between wages and salaries paid by manufacturers and the total net value of production. Figures of gross production are often erroneously used in such calculations, but the values out of which the wages of employees must in the long run come are the values added to the raw materials while they are in the factory."

A study of Canadian statistics from this point of view has revealed a relationship that is of particular interest to the chemist, namely, that the chemical industries are characterised by a very low ratio of wages plus salaries to added value.

Census data for the major groups of Canadian manufactures are analysed in Table I, while in Table II are presented the ratios for the component industries of the chemical group. In Table III are listed the values for still other industries that are based for the most part on chemical processes.

An inspection of this material reveals the fact that in the chemical industries less than 10 per cent. of the ratios are equal to or greater than the average for all industries, while the majority are considerably below this average, a conclusion that confirms the general validity of the low value of the chemical group in Table I. About two-thirds of the industries of Table III are below the average for all industries.

TABLE I.

Percentage Ratios of Wages Plus Salaries to Added Value for Major Groups of Canadian Industries

	1920	1924	1928
All industries	43	45	42
Vegetable products	32	32	28
Animal products	35	49	46
Textiles and textile products	49	55	54
Wood and paper products	41	49	46
Iron and its products	56	57	56
Non-ferrous metal products	53	51	34
Non-metallic mineral products	40	38	33
Chemicals and chemical products	34	22	28

TABLE II.

Percentage Ratios of Wages Plus Salaries to Added Value for Canadian Chemical Industries.

	1925	1927	1929
Coal tar distillation	21	19	24
Acids, alkalies and salts	23	22	18
Compressed gases	28	29	25
Explosives, ammunition & fireworks	39	27	23
Medicinal, pharmaceutical and toilet preparations	30	28	30
Pigments, paints and varnishes	32	29	26
Soaps and washing compounds	41	36	29
Wood distillation	21	38	27
Adhesives	36	35	37
Inks	40	39	40
Fertilisers	52	35	34

TABLE III.

Percentage Ratios of Wages Plus Salaries to Added Value for Other Canadian Industries Employing Chemical Processes.

	1920	1924	1928
Pulp and paper	30	35	23
Coke	78	25	22
Illuminating and fuel gas	47	43	43
Distilled liquors	23	14	9
Wine and grape juice	35	33	24
Linseed oil and oil cake	15	27	42
Malt	25	11	24
Brewery products	26	29	18
Tallow and animal oils	23	68	55
Textiles, dyed, cleaned and finished	53	56	52
Starch and glucose	48	41	37
Refined sugar	30	28	32
Tanned leather	48	48	50
Glass	53	52	44
Petroleum products	32	47	27
Artificial ice	48	39	27

The economic background of chemical manufacturing requires further study before the significance of this low ratio can be explained satisfactorily. The present discussion is for the purpose of outlining the problem, in the hope that more exhaustive study may point out the responsible factors.

Inherent in ratios of this type is the possibility of making international comparisons when adequate statistics are available. Other aspects of manufacture, such as the

way. On these lines an extremely high overall thermal efficiency is obtained so that in a given establishment the combined electricity and coal bill for heating and lighting is much below that of purchasing electricity from an outside power station and heating the buildings with a separate system, as the one boiler plant supplies the steam for both purposes. In connection with such generating plant Belliss and Morcom Ltd., of Birmingham, for example, have specialised for over 30 years and have supplied upwards of 1,450 combined steam and power heating installations to all kinds of undertakings, especially in the chemical, dyeing, paper, and sugar industries. The reason of the substantial economy obtained by such a combined system is the latent heat of steam, the fact that when liquid water is converted into gaseous steam a very large amount of heat is absorbed or rendered "latent" because of the great increase of volume, and this heat is given up again when the steam condenses. Consequently at a power station or large works where electricity is generated by condensing turbines about 60 per cent. of the total heat in the coal is thrown away in the cooling water, of which there is required about 450-500 per ton of coal burnt. With a back-pressure engine, however, all this heat in the exhaust steam is usefully employed in general process work including the warming of buildings, so that the actual thermal efficiency is about 50-60 per cent. as compared with only about 15-18 per cent. for power stations.

THE WELLCOME FOUNDATION MEDICAL AND CHEMICAL RESEARCH BUILDING.

The Wellcome Foundation, Ltd., is about to erect a new medical and chemical research building at the corner of Gordon Street and Euston Road on the site, 225 feet by 135 feet, now partly occupied by their Bureau of Scientific Research. During many years the Foundation has maintained medical and chemical research laboratories, but recent developments have made it necessary to co-ordinate and extend these activities. The new building will furnish the additional accomodation required, and be provided with most modern research equipment. Mr. Septimus Warwick, F.R.I.B.A., is the architect.

"ETHACTION" — A MECHANISM OF THE UNIVERSE.

Mr. F. J. Winser, M.P.S., has sent us a note of his with the above title. He points out that all that we know of is in motion and for motion to be possible it is necessary to have body or substance. We cannot imagine motion apart from substance nor do we know substance apart from motion.

In order to solve the mysteries and understand many of the wonders which exist around us we must regard space as *being absolutely filled with moving substance*, *i.e.*, Ether combined with Energy or Action. "Eth-action" expresses this combination. All space therefore is Ethactive and it follows that all formations and all activities whether material or immaterial are the result of Ethaction, the essence or basis of all.

Matter. Centres of "Ethactivity."

The three forms of matter, Electrons, Atoms and Worlds are centres of Ethactivity. To explain this let us first consider the electron, the simplest form. An electron is simultaneously a minute centre of Ethactive current and of Ethactive Radiation, the current becoming transformed into Radiation at the central point. A minute star-like formation will well express it.

As the current approaches the central point, the space offered for passage gradually decreases, in consequence of which, the speed gradually increases. On reaching the central point, the space is at a minimum, while the speed is at a maximum and it is there where the current is tranformed into radiation. The outrushing rays gradually give up their power, creating other rays of less intensity and these again others until the whole becomes split and diffused, eventually taking part in the formation of current elsewhere. Thus current creates and supports radiation, while radiation creates and supports current. We have therefore a cycle of change which is continuous. An atom is a secondary centre of similar nature being composed of electrons in the form of a tiny sphere, and governed by current and radiation. World is composed of a multitude of atoms forming a tertiary centre and likewise governed by current and radiation.

Attraction and Revolution of Matter.

We have seen that the three forms of matter all possess Ethactive Current. Let

us see what bearing this has on what is known as the attraction of matter. Our most obvious example will be the Earth's attraction of the Moon. The Moon being sufficiently near the Earth is within the Earth-current. The Earth-current therefore extends beyond the Moon forcing the Moon towards the Earth's Centre, but owing to the Moon also possessing current, at a certain point here known as the point of opposition in between these two bodies or centres, the current will be flowing in two opposite directions, *i.e.*, one flow will be directed towards the Earth's centre and the other towards the Moon.

The larger as well as the less dense bodies will be found at a greater distance apart because with large bodies the double flow of current at the point of opposition is greater, while with the less dense force of flow is necessary at that point.

"Ethactivity Valency."

Matter may possess a high or low degree of "Eth-activity." The space which is relatively most densely occupied by centres will be found highly Ethactive and visa versa, and upon this what is known as the Valency of Atoms depends. For example, The Carbon atom possesses Eth-activity in a high degree and in consequence of its powerful Ethactive Current coupled with its lightness it becomes that great builder of the many Carbon Compounds. The Lithium atom being a less dense atom possesses less electrons but occupies approximately as much space as Carbon and is therefore less Ethactive. Again Nitrogen also less dense possesses more electrons but occupies greater space which renders this also less Ethactive. The valency of Lithium being 1. Carbon 4. Nitrogen 3.

SCIENTIST'S ROCKET EXPLODES.

A rocket costing £800, and laden with scientific instruments which the American scientist, Dr. D. O. Lyon, had arranged to fire sixty miles into the air in order to obtain samples of the upper atmosphere, exploded thirty miles north of Milan, gravely injuring three men. Dr. Lyon believed that it would furnish valuable data for a better attempt to reach the moon, or at least for a cruise in inter-planetary space. He has not yet given up hope of constructing a rocket to carry a man on its trip.

GENERAL NOTES

THE FASTEST DYESTUFF IN THE WORLD.

British Triumphs at the Albert Hall.

The exhibit of British dyestuffs shown at the Artificial Silk Exhibition at the Albert Hall on February 16, affords ample proof of the lead that the British Dyestuffs holds in the field of dyes for artificial silk.

It demonstrated the excellent use which our dye-makers have made of the opportunities afforded them by the Dyestuffs Act.

Artificial silk is the only textile in the dyeing of which the new British Dyestuffs Industry were able to start on equal terms with their competitors. The result is that in the treatment of artificial silk British dyes are supreme.

Among the wide range which was shown at the Albert Hall, especial interest centred in an evening frock dyed with the world's famous Caledon Jade Green. This is the world's fastest dye. The product of British chemists in a Scottish laboratory this dye is of a brilliant green shade and is one of the large number of dyes of the Caledon type which range through all the colours of the spectrum.

Another interesting development is the range of Duranol colours. For some time artificial silk of the acetate type, as opposed to the pure cellulose, could not be dyed satisfactorily. Here again it needed British discovery of what are now known as the Duranol range of dyes, which though of outstanding fastness could be used with the utmost simplicity. Examples of the application of these colours were shown in several articles of ladies' clothing.

In addition, ranges of both colours were shown on the stand arranged by Imperial Chemical Industries at the Albert Hall, which was the most brilliantly coloured exhibit in the show.

BUYING SEASONS IN TURKEY, PALESTINE, SYRIA, IRAQ, PERSIA, ETC.

Memorandum on Buying Seasons for some of the principal goods imported into Turkey, Palestine, Syria, Iraq, Persia, and Hejaz and Nejd, has been prepared by the British Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, and copies can be obtained by interested British firms on application to that Department (quoting Reference C. 3443).

ECONOMIC CONDITIONS IN THE BRITISH WEST INDIES AND CONTINGUOUS BRITISH TERRITORIES.

The general conditions and outlook as regards local production and trade are reviewed briefly in the Introduction, attention being drawn to the depressed condition of tropical agriculture, which is passing through a serious period in regard to certain staple products such as sugar, cocoa, coconuts, etc. This state of affairs is ascribed mainly to low values, plant diseases, insect pests and, in the case of limes, to the hurricane of September, 1930, which, in addition to destruction of crops, was responsible for loss of life and for considerable damage to property in the island of Dominica.

Extensive measures are being and have been taken to cope with the evils threatening that section of the population dependent upon agriculture for its economic welfare amongst which may be enumerated the appointment, in the autumn of 1929, of a Sugar Commission, which has reported on the condition of the industry, the closer attention given to the cultivation of varieties of fruit and vegetables not at present affected by the foregoing considerations and to the stimulation of interest in the crushing for oil and the manufacture for domestic consumption of surplus coconut products.

It is satisfactory to record that the mineral industry in the territories under review is in a flourishing condition and, as the Trade Commissioner observes, the Trinidad oil production is increasing in value not only to the Colony itself, but to the Empire as a whole. The Trade Commissioner further states that in 1929, for the first time, Trinidad produced more oil than any other part of the British Empire.

The financial situation of the various colonies is dealt with in chapter II. The latter chapter contains a section on "Capital for Industrial Development," which refers to the prospective need for foreign capital for possible future developments, especially in regard to sugar and its byproducts. In chapter III, agricultural production and prospects receive comprehensive treatment, particularly in regard to sugar, cocoa, coconuts, cotton and other staple West Indian agricultural products. There are also separate sections of this chapter devoted to forests, mineral products, marine products and to the tourist trade.

The Trade chapter commences with a résumé of the total imports into the area covered by the Report, and is followed by sections dealing with different phases of foreign commerce, such as competition, business connections, etc. It is observed that although the balance of trade with the United Kingdom is decidedly favourable to this country, there is yet considerable competition to be faced from the United States and Canada. The increasing growth of steamship communications is doing much to foster Canadian trade with the West Indies, but so far expansion has been at the expense of United States trade rather than that of the United Kingdom. It is also noteworthy that, although United States trade gained so much ground in the West Indies during the war, much has been subsequently recovered by the United Kingdom in many important lines. The information contained in this chapter is supplemented by detailed appendices (II and III), giving comparative particulars of the principal imports and exports into and from Barbados, British Guiana, Trinidad, and Jamaica respectively, distinguishing the chief sources of supply or the countries of destination as the case may be. Summarised particulars in respect of each colony separately are given in appendix I.

Some particulars regarding certain public and municipal works, either in hand or contemplated, are given in chapter V, the informatios contained therein being supplemented by a list of schemes recommended by the Colonial Advisory Committee contained in appendix V.

A list of certain laws affecting trade is given in the chapter on Commercial Legislation, which is followed by chapter VII on Communications. The section on shipping given in the latter chapter contains notes of some important developments under this head. In appendix IV will be found the agenda of the First West Indies Conference, 1929.

THE SALT INDUSTRY OF CANADA.

The Canadian Department of Mines has just published a work by L. Heber Cole, on "The Salt Industry of Canada" (116 pp. with many maps and illustrations).

The salt industry of Canada is one of the oldest non-metallic industries of the coun-

try, dating back to the early years of the last century when the Hudson's Bay Company obtained their local supplies from the brine springs of the Mackenzie basin.

The discovery of salt in Ontario in 1866 was, however, the real beginning of the industry on a substantial basis, and production from the Ontario field has been continuous since that time. The opening of the Malagash deposits in Nova Scotia in 1918 inaugurated the first rock salt mine in the country, and has materially assisted in supplying the demands for salt in the Maritimes.

With the discovery of rock salt at McMurray in Alberta, the prospect of extending the industry to the western provinces is bright.

Salt finds a use in a large number of industries, and the consumption for domestic use forms a steady demand, dependiug on the population. The increasing use of salt in Canada for the manufacture of chemicals has in recent years caused a rapid rise in the production of salt, and there is every reason to look forward to a rapid expansion of the industry as the country grows.

The present report has been prepared to meet the demand for information relating to the Canadian salt industry. It is now over 14 years since the report The Salt Deposits of Canada and the Salt Industry was published by the Mines Branch, and a number of new deposits have been discovered and extensive development has been made in that time.

MERCHANDISE MARKS ACT, 1926.

Air and Gas Compressors and Exhausters : Pneumatic Tools : and Parts Thereof.

The Standing Committee (General Merchandise) appointed by the Board of Trade have reported on their enquiry as to whether the following descriptions of imported goods should be required to bear an indication of origin :—

(*a*) Air and gas compressors and exhausters, and beds, casings, cylinders, rotors and heads therefor.

(*b*) Pneumatic tools and appliances, including mining coal cutters operated by compressed air, and cylinders, heads, pistons and valves therefor.

The Report (Cmd. 3783) is obtainable from the Stationery Office, either directly through any bookseller, price 2d.

TENDER FOR DRUGS FOR EGYPT.

The Egyptian Department of Public Health is calling for tenders, to be presented in Cairo by the 16 April, 1931, for the supply of drugs, etc., the specification for which covers proprietary articles, drugs and chemicals, galenicals and packed articles.

Firms desirous of offering drugs prepared in the Uuited Kingdom can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number F.X. 1026 should be quoted.

KEY INDUSTRY DUTY : EXEMPTION OF VARIOUS CHEMICALS.

The British Treasury have made an Order under Section 10 (5) of the Finance Act, 1926, exempting acid isobutyl allyl barbituric; acid propionic; butyl methyl adipate; calcium gluconate (calcium glyconate); chinoline (quinoline); strontium carbonate; strontium nitrate, from Key Industry Duty from February 3 to December 31, 1931.

The Treasury Order will shortly be published by H.M. Stationery Office.

POLAND.

Methods of Quoting and Terms of Payment.

A confidential memorandum on methods of quoting and terms of payment prevailing in relation to business with Poland prepared by the Commercial Secretary to His Majesty's Embassy at Warsaw has been received and issued by the Department to firms whose names are on its Special Register. British firms who desire to obtain a copy of the memorandum and particulars of the Special Register service should apply to the Department. (Reference No. C.X. 3448 should be quoted .

NEW CHEMICAL INDUSTRIES IN ONTARIO.

In a recent issue of the Toronto journa. —" Canadian Chemistry and Metallurgy," a description is given of the new contact sulphuric acid and nitre cake plants recently established by Canadian Industries, Ltd., at Copper Cliff near Sudbury, Ontario. This nitre cake plant is the first in Canada designed and constructed for the direct production of nitre cake (sodium acid sulphate).

GAS DESERVING OF BETTER RECOGNITION BY GOVERNMENT.

Strong criticism of the action of the Minister of Transport (Mr. Herbert Morrison) in throwing the weight of his influence on the side of the interests of electricity and against those of the gas industry, is contained in the Annual Report of the Directors of the South Metropolitan Gas Company, which was sent to shareholders and presented at the Annual General meeting on February 4.

In the United States says the report, "the suppliers of electric and of gaseous energy have been left to compete for business as commercial undertakings, existing for the general weal and without discouragement of either by the Government. In this country, on the other hand, the Minister of Transport has seen fit to throw the weight of his influence into the scale on the side of the interests of electricity, and therefore to that extent to the detriment of gas.

"It is obvious that the arbitary displacement and compulsory exclusion of gas in favour of electricity must involve a definite loss of business to the gas undertaking. An industry which for more than a century has fulfilled and is fufilling a great purpose in the economic utilisation of the country's coal resources, which in London alone gives employment to some thirty-thousand persons, excluding those employed in ancillary undertakings, and which continued to function unaided when electric power stations had to be manned by naval-ratings during the general strike, surely deserves better recognition from the Government responsible for the health and welfare of the country."

The report signed on behalf of the Board of the Company by Dr. Charles Carpenter, who is both President and Managing Director.

In a letter to the Editor, Mr. J. C. Thomlinson, B.Sc., ventures the opinion that had Priestley's views concerning "igneous particles" been considered in conjunction with The Atomic Theory these would probably have anticipated recent developments in connection with electrons and atomic energy.

GERMAN FOREIGN TRADE IN 1930.

Although the value of exports was 11 per cent. less than in 1929 their volume was only 5 per cent. smaller. Manufactures decreased only 8 per cent. in value. Total

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

February 12.

The following papers were read :—

The Pigmentary Effector System. By L. Hogben and D. Slome. Communicated by H. H. Dale, Sec., R.S.

Brains of Cyprinoids and Habits of Feeding. By H. Muir Evans. Commuuicated by H. H. Dale, Sec., R.S.

The following papers were read in title only :—

The Osmotic Changes in Some Marine Animals. By R. Margaria. Communicated by A. V. Hill, F.R.S.

Some Aliphatic and Aromatic Amino Derivatives of α-Quinoline Methiodide. By J. B. Cohen, F.R.S., K. Cooper, and P. G. Marshall.

Mauy of the amino and acylamino compounds obtained by the condensation of derivatives of α-methyl quinoline with nitrosoarylamines possess active antiseptic and in some cases mild trypanocidal properties. It appeared interesting to examine the physiological effect of substances obtained by attaching a basic aliphatic or aromatic side-chain directly to the α-carbon of the suinoline nucleus. A variety of these substances were prepared and submitted to Professor Browning, of Glasgow University, but they exhibited no marked antiseptic or trypanocidal character. Similar reactions have been carried out with diamino compounds of aliphatic and aromatic series with basic groups at both ends of the chain in the hope that they might exhibit antimalarial action, but no such effect was observed.

The Antiseptic and Trypanoidal Action of Certain Styryl and Anil Benzthiazole Derivatives. By C. H. Browning, F.R.S., J. B. Cohen, F.R.S., S. Ellingworth, and R. Gulbransen.

The antiseptic and trypanocidal actions of anil and styryl benzthiazole compounds have been investigated. The substances examined are analogues of the more active members of the anil and styryl quinoline series previously reported on. The anil benzthiazole derivatives are relatively weakly antiseptic for staphylococcus and *B. coli*, as compared with the quinoline analogues which are highly active in this respect. Several benzthazole styryl compounds have produced cure of mice infected with *Trypanosoma brucei* and the same

and trypanocidal action have been found to hold as in the styryl quinoline series. Thus the maximum effect is produced when one nucleus contains a basic group and the other an acetylamino group. The anil benzthiazole series, in general, possesses some trypanocidal action, but cure has only exceptionally been produced.

Studies on Epithelial Phagocytosis, I. By H. M. Carleton. Communicated by Sir Charles Sherrington, F.R.S.

The Ureides of p-Aminophenylstipinic Acid. By W. H. Gray, J. W. Trevan, H. W. Banibridge, and A. P. Attwood. Communicated by H. H. Dale, Sec., R.S.

On the Optimum Hydrogen Ion Concentration and Temperature of the Style Enzyme of Pecten Maximus. By A. Graham. Communicated by E. J. Allen, F.R.S.

The Physiological Action of Cyanide, I. By C. S. Hanes and J. Barker. Communicated by F. F. Blackman, F.S.R.

THE CHEMICAL SOCIETY.

Papers read Thursday, February 5 :—

Salt-forming Characteristics of Doubly and Singly Linked Elements of the Oxygen Group. Part I. The Carbonyl Group in Benzaldehyde and Acetophenone. By J. W. Baker.

Part II. The Nitration of Benzaldehyde and Acetophenone in Sulphuric Acid Solution. By J. W. Baker and W. G. Moffitt.

The conclusions already reached from physical data (preceding paper) concerning the existence of benzaldehyde and acetophenone as oxonium salts in sulphuric acid solution have been confirmed by a study of the proportions of the *m*-nitro-derivative formed by nitration of these compounds in the presence of sulphuric acid of various concentrations. The presence of the positive charge on the cation PhCR : OH of the salt form causes a considerable increase in the proportion of *m*-nitration observed under these conditions. Thus in sulphuric acid containing 7.3 per cent. of free sulphur trioxide benzaldehyde and acetophenone afford 90.8 and 90.0 per cent. of the *m*-nitro-isomeride, respectively. The proportion decreases gradually as the concentration of the sulphuric acid is diminished until in 80 per cent. sulphuric acid the values are 83.9 and 83.1 per cent. of *meta*, respectively. Moreover, in all cases, the addition of ammonium sulphate to the nitrating medium causes a depression in the amount of the *m*-isomeride formed, comparable in both magnitude and type to that observed in the case of the ψ-base benzylidene-*m*-nitroaniline, thus proving that substitution occurs mainly through the cation of the oxonium salt. The formation of a loose salt-like complex, even in nitric acid alone, is suggested by the slight fall in the proportion of *m*-nitration (70° in nitric acid d^{15} 1.53 to 66.9 in acid d^{15} 1.485) as the dilution of the acid is increased.

The Properties of the Chlorides of Sulphur. Part V. Metastable States. By T. M. Lowry and G. Jessop.

The period of induction in the combination of ulpshur monochloride with chlorine can be eliminated or reduced by catalysts such as iodine and antimony pentachloride or by autocatalysis. The fact that mixtures rich in chlorine are better autocatalysts than mixtures rich in sulphur monochloride can be explained by attributing the catalysis to traces of the two tetrachlorides SCl_4 and S_3Cl_4.

The combination of sulpbur dichloride and chlorine to form solid sulphur tetrachloride is instantaneous even at −80°, and no lag can be detected in the restoration of euilibrium when the tetrachloride is melted at temperatures below −20°.

The freezing and melting of sulphur tetrachloride in a well-stirred sample of sulphur dichloride is accompanied by a lag, which varies with the temperature in the same way as the lag in the reciprocal transformation of two forms of ammonium nitrate on either side of the transition temperature at 32°.

A displacement with temperature of the equilibrium-concentrations in samples of sulphur dichloride has been established by observations of density by the flotation method. From these data it has been deduced that the degree of dissociation increases from about 15 per cent. at 0° to about 25 percent. at 100°.

Polycyclic Aromatic Hydrocarbons. Part II. The Non-existence of 1 : 2 : 7 : 8-Dibenzanthracene. By J. W. Cook.

The hydrocarbons formed by pyrolysis of 2-methyl 1 : 1′dinaphthyl ketone (I) and 2-methyl-1 : 2′-dinaphthyl ketone, supposed to be 1 : 2 : 7 : 8-dibenzanthracene and 1 : 2 : 5 : 6-dibenzanthracene (II), respectively (Clar, *Ber.*, 1929, LXII, 350: Fieser and Dietz, *ibid.*, 1827), are not isomeric, but identical. This hydrocarbon is 1 : 2 : 5 : 6-dibenzanthracene, which has been synthesised by another method by Weitzenböck and Klinger, so that 1 : 2 : 7 : 8-dibenzanthracene has not yet been prepared.

Part II. Derivatives of 1 : 2 : 5 : 6 :-*Dibenzanthracene.*

In continuance of a search for cancer-producing compounds of known structure, attention has been directed, on biological and spectroscopic grounds, to derivatives of 1 : 2 : 5 : 6-dibenzanthracene. Two *methyl* derivatives have been prepared by pyrolysis of the *ketones* formed by condensing methylnaphthalenes with methylnaphthoyl chlorides. The reaction is limited to the production of compounds with substituents in positions 2′ and 3′, on account of the lability of methyl groups attached in an α-position to a condensed nucleus. 9 : 10-*Dimethyl*, 9 : 10-*di-n-butyl* and 9 : 10-*dibenzyl* derivatives of 1 : 2 : 5 : 6-*dibenzanthracene* have been obtained by reduction of the *diols* resulting from 1 : 2 : 5 : 6-dibenzanthraquinone and magnesium alkyl halides.

Part IV. Condensed Derivatives of 1 : 2-*Benzanthracene.*

The Elbs method of formation of the anthracene ring system has been extended to the production of new benzanthracene hydrocarbons containing six and seven condensed rings. The *ketones* from hydrindene, acenaphthene, and fluorene, by condensation with 2-methyl-1-naphthoyl chloride, were converted by pyrolysis into *cyclopentenobenzanthracene*, *benzacenaphthanthracene*, and *phenanthrenofluorene* respectively; from the ketones prepared from 3-phenanthroyl chloride and 1-anthroyl chloride by treatment with the Grignard compound of 2-methyl-1-bromonaphthalene were obtained *phenanthrenophenanthrene and phenanthrenoanthracene.* 2 : 6-Dimethyl-1 : 2′-dinaphthyl ketone and benzoyl chloride yielded a *diketone*, and this was pyrolysed to a *benzonaphthochrysene.*

Structural formulæ are suggested for these hydrocarbons.

THE PHYSICAL SOCIETY.

Friday, February 6.

The following papers were read :—

The Radiation-Reflecting Powers of Rough Surfaces. By H. E. BECKETT, B.Sc.

A study of the reflecting properties of building materials for solar radiation has been made, a hemispherical mirror being used for integrating diffusely-reflected energy upon a thermopile receiver. The paper follows the work of Coblentz and Royds and deals at length with the errors inherent in the method and with the adjustment of the apparatus. The theory of the method is simplified by the introduction of an auxiliary specimen which, in particular, renders the observations independent of the degree of blackness of the thermopile receiver. Reflecting powers for a large number of building materials are given for four radiation bands within the solar range, and also for the composite radiation obtained by the screening of a pointolite lamp with a thin gold film. The latter radiation somewhat resembles that of the sun in range and distribution, and enables the reflecting power of a surface for total sunlight to be determined approximately in a single reading. The apparatus has been tested with magnesium-carbonate surfaces and yields reflecting powers in the visible spectrum in good agreement with those found photometrically.

A Ballistic Recorder for Small Electric Currents. By E. B. MOSS, B.Sc.

The standard thread recorded is so modified that it records ballistic throws in place of the usual steady deflection. By this means the current-sensitivity may be increased at least twenty-five times.

The Instrumental Phase-Difference of Seismograph Records; an Illustration of the Properties of Damped Oscillatory Systems. By F. J. SCRASE, M.A., B.Sc., Kew Observatory.

A discussion is given of the method of interpretation of the maxima shown on the records of earthquakes during the surface wave phase. The usual procedure is to treat the waves (which actually appear as beats) as being truly simple harmonic and to apply the formulæ which are derived on this assumption. It is shown that, in general, this procedure does not necessarily lead to the correct interpretation. In the case of direct registration the true earth maximum may have occurred one half-period later than the time obtained by the usual correction. With galvanometric registration the maximum may have occurred either one, two, or three half-periods earlier than the time indicated by the usual formula due to Galitzin. Some curves are included to illustrate these points, and an attempt is made to obtain mathematical explanation.

It is shown that there is no easy method of eliminating an ambiguity of one half-period. For direct registration, therefore, the phase correction at present in use appears to be as good as the one alternative. In the case of galvanometric registration, although there are altogether four forms of phase correction, the number of alternatives for any particular period cannot exceed two. The final recommendation in this case is that the correction suggested by Somville and which is one half-period less than Galitzin's, be adopted for general use.

January 16.

The Theory of the Microscope. By L. C. MARTIN, D.Sc., A.R.C.S., D.I.C.

The paper examines the diffraction-effects produced by (*a*) two adjacent apertures, and (*b*) a series of apertures in an opaque screen situated in the focal plane of a lens system, when the illuminating system is projecting the elementary image of a point-source of light into this object plane. The diffraction-effects and geometrical resolving power of the grating are shown to be independent of the concentration of the light in the object plane; they depend rather on the number of apertures free to transmit light. The theory is then extended to the case where the illumination of the object is produced by a source of finite area. Both the equivalence and Abbe principles appear in the analysis of the mode of formation of the image in such critical illumination, but subject to the difficulties encountered in integration for the effects of finite sources of light. Confirmatory experimental work is in hand.

January 16.

Further Experiments on Magnetostriction Oscillators at Radio-Frequencies. By J. H. VINCENT, M.A., D.Sc., F.Inst.P.

Work on magnetostriction oscillators at radio-frequency is continued from a previous paper. It is shown that the coil surrounding the bar can be in either branch of a simple tuned anode circuit. When the bar-coil is in the inductive branch the circuit may be operated as a series or parallel arrangement; in the latter case the direct plate-current does not pass through the inductive branch of the fly-wheel circuit. The variation in either the anode- or the grid-current can be used to indicate resonance. Comparative experiments with corronil, nickel and glowray suggest that glowray is the most suitable of these materials for high-frequency oscillators. The experiments are carried on to the case of a glowray oscillator 1.9 mm. long which has a frequency of 1280 kc.-sec. and weighs less than a fiftieth of a gramme.

The Equivalent Circuit of the Magnetostriction Oscillator. By S. BUTTERWORTH, M.Sc., AND F. D. SMITH, M.Sc., A.M.I.E.E.

The Joule effect in magnetostriction is defined by the relation $S=\lambda B$, where S is the stress produced by a small increment of induction B of an existing induction B_0; and the converse effect by the relation $H=\kappa\xi$, where H is the magnetic field produced by a small strain ξ. Conservation of energy requires that $\kappa=4\pi\lambda$. These equations are used in investigating the motion of a magnetostriction oscillator consisting of a closed circular ring inside a toroid, eddy currents and hysteresis being taken into account. It is shown that the oscillator can be represented by an equivalent electrical circuit comprising a pair of parallel impedances Z_e, Z_m, in series with an impedance Z_l, where Z_l represents leakage impedance and Z_e impedance due to core flux in the absence of motion, while Z_m is a resonant shunt to Z_e and represents the effect of the motion. Expressions for the elements of the circuit in terms of the fundamental constants of the material are given. The circle-diagram of impedances is deduced, and the modifying effects of eddy-currents and hysteresis are investigated. Some simple geometrical relations between the vectors in the diagram are derived. It is shown that the size of the circle diagram for solid material having a large value of λ depends mainly upon permeability and resistivity and only slightly upon λ, and that a high degree of resonance may be associated with poor magnetostriction quality; the circle-diagram may, in fact, lead to erroneous conclusions unless interpreted in the light of an adequate theory. An experimental investigation of the resonant radial vibrations of solid and laminated nickel rings verifies the theoretical deductions and leads to numerical values of λ and κ in agreement with values deduced from the work of Masumoto and Nara and of McKeehan and Croffi. For nickel in the annealed state, $\lambda=1.76 \times 10^4$ and $\kappa=22.1\times10^4$ at a point on the curve corresponding to $H_0=14.5$ gauss.

CANADIAN MINES OUTPUT IN 1929.

This amounted to $310,000,000 as compared with $172,000,000 in 1921.

NOTICES OF BOOKS.

Casopisectvo v Cechách v letech 1848-1862 (*Periodical Literature in Bohemia,* 1848-62). By Dr. F. Roubik. Pp. 208, with 10 Appendixes and 16 plates. Prague: Nakladem Vydavatelstva Ducha Novin. 1930. Price 35 Czech Crowns (4s. 4d.).

In this volume of *The Chemical News,* page 62, a notice of the History of the Press in Bohemia to 1848, by Dr. J. Volf was given. This history has been quickly followed by Dr. Roubik's Periodical Literature in Bohemia during the years 1848-32. The abolition of the press censorship in the first year of this epoch stimulated the appearance of numerous journals. In 1848 Bohemia possessed 100 periodicals, 41 of which were in Czech and the rest in German. In 1856, we learn, the number had dropped to 37, only twelve of which were Czech, but the number had again risen to 68 (35 Czech) by 1862 when new press laws came into force.

Dr. Roubik's volume is of more than usual value since he has classified the publications both chronologically and geographically and the appendixes include a list of the editors and tables with dates of publication, classification into scientific, industrial, pedagogic, art, political and humorous periodicals. Statistics of the number of subscribers and copies printed are also shown and it is interesting to observe that the scientific and cultural organs had relatively high circulations although there was a noticeable drop in the early fifties.

Of the three scientific journals in Czech, apparently only the *Bulletin* of the Czech Academy of Science has survived. During the period covered by this book there were ten pedagogic publications, eleven Czech industrial organs, six German popular science journals and four cultural periodicals. The author has ventured to point out those that were of high literary standard and for readers interested in Central European affairs this work is of considerable importance. A final volume on the history of periodical literature in Bohemia from 1862 to the end of the nineteenth century is promised and will be awaited with interest.

J. G. F. Druce.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Tuesday, February 24, at 4.30 p.m.—(Dominions and Colonies Meeting). "The Hard Fibre Industry—with Special Reference to the British Empire." By Alfred Wigglesworth.

Wednesday, February 25, at 8 p.m.—(Ordinary Meeting.) "Development in Television." By W. G. W. Mitchell, B.Sc.

ROYAL INSTITUTION.

21, Albemarle Stieet, W.1.

Friday, February 20, at 9 p.m.—"Prehistory in the Light of Genetics." By J. B. S. Haldane.

Tuesday, February 24, at 5.15 p.m.—"Adhesion" (I). By Sir William Bragg.

Thursday, February 26, at 5.15 p.m.—"Respiration." By J. B. S. Haldane.

Friday, February 27, at 9 p.m.—"The Re-birth of India." By Sir Francis Younghusband.

THE INSTITUTE OF METALS.

Birmingham Local Section.

Thursday, February 26, at 7 p.m., in the Chamber of Commerce, New Street, Birmingham.—"*Press Tools for Sheet Metal* Working." By J. L. Williams.

MANCHESTER CHEMICAL SOCIETIES.

Society of Dyers and Colourists.

Friday, February 6, at 7 p.m., in the Lecture Room of the Manchester Literary and Philosophical Society, 36, George Street, Manchester.—"Solazol Dyestuffs." By J. S. Wilson. (Members are reminded that they will have an opportunity of reading short papers on April 17, and are asked to give notice of such papers to the Hon. Secretary.)

Oil and Colour Chemists' Association and Institute of Rubber Industry.

Friday, February 27, at 7 p.m., at Milton Hall, Deansgate.—"Colours Used in the Rubber Industry." By G. F. Thompson, A.I.R.I. (Sc.) and E. V. Bratby, A.I.R.I. (Sc.).

GEOLOGICAL SOCIETY OF LONDON.

Burlington House, W.1.

The Fellows of the Society are informed that the Annual General Meeting to elect the Council and Officers for the ensuing

year will be held at the Apartments of the Society in Burlington House, on Friday, February 20, at 3 p.m. The President's Address will be read during this Meeting.

INSTITUTE OF CHEMISTRY.

BELFAST AND DISTRICT SECTION.

Wednesday, February 25, at 7.30 p.m., in the Physics Lecture Theatre of the Royal Belfast Academical Institution. — " The Effects of Air Humidity on Cellulose." By J. A. Matthew.

BRITISH INDUSTRIES FAIR, 1931.

February 16 to 27.—London : Olympia and White City. Birmingham : Castle Bromwich. Open daily at 9.30 a.m.

INSTITUTE OF METALS.

Friday, February 20—Official Visit to the British Industries Fair at Birmingham. Full particulars may be obtained from Dr. G. Shaw Scott, 36, Victoria Street, London, S.W.1.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.

Tuesday, February 24, at 7.30 p.m., at 39, Elmbank Crescent, Glasgow, C.2. " Supercharging With Special Reference to Werkspoor Engines." By G. J. Lugt.

SOCIETY OF GLASS TECHNOLOGY.

An ordinary general meeting will be held in the Applied Science Department, The University, St. George's Square, Sheffield, on Wednesday, February 25, at 2 p.m. The following papers will be read :—

" The Use of Ammouium Sulphate in Accelerating the Melting of Glass. Part I. Experimental Small Scale Meltings." By M. Parkin, M.Sc., Professor W. E. S. Turner, and W. J. A. Warren, B.Sc.

Part II. " Experimental Meltings in a Tank Furnace." By the Research Staff of Messrs. Imperial Chemical Industries, Ltd.

" The Temperature of Incipient Glass Formation." By J. T. Howarth, M.Sc., Ph.D., and Professor W. E. S. Turner.

JAPANESE CHEMICAL INDUSTRIES EXHIBITION.

The Third Chemical Industries Exhibition, under the auspices of the Kwagaku Kogyo Kyokwai (The Chemical Industries Association), will be held at the Uveno Park in Tokyo, from March 20 to April 30.

THE FARADAY SOCIETY.

General Discussion on " Photochemical Processes," in the Department of Chemistry, Liverpool University, on April 17 and 18, 1931.

PROVISIONAL PROGRAMME.

Friday, April 17, 10 a.m. to 1 p.m.—I. " Molecular Spectra in Relation to Photochemical Change." Introductory paper by Professor R. Mecke.

Friday, April 17, 2.30 p.m. to 6.30 p.m.—II. " Photochemical Kinetics in Gaseous Systems." Introductory paper by Professor M. Bodenstein.

Saturday, April 18, 10 a.m. to 1 p.m.—III. " Photochemical Change in Liquid and Solid Solutions." Introductory paper by Professor Berthoud.

Saturday, April 18, 2.30 to 4.30 p.m.—IV. " Photosynthesis." Introductory paper by Professor E. C. C. Baly.

SOCIETY OF DYERS AND COLOURISTS.

MANCHESTER SECTION.

The Sixth Meeting of the Session will be held on Friday, February 20, 1931, at 7 p.m., in the Lecture Room of the Manchester Literary and Philosophical Society, 36, George Street, Manchester.

The following paper will be read :—

" Solazol Dyestuffs." By J. S. Wilson, Esq., M.Sc.

Members are reminded that they will have an opportunity of reading short papers on April 17, and are asked to give notice of such papers to the Hon. Sec.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

3,178.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 1 : 2 : 5 : 6-diphthaloyl naphthalene homologues, etc. January 31.

2,959.—Krollpfeiffer, F.—Manufacture of new products from 7-iodo-8-hydroxyquinoline-5-sulphonic acid, etc. January 29.

Specification Published.

341,970.—I. G. Farbenindustrie Akt.-Ges. —Process of the manufacture of derivatives of 3-nitro-4-hydroxybenzamide.

Abstract Published.

339,875.—*Destructive hydrogenation.* — Naamlooze Vennootschap Bataafsche Petroleum Maatschappij, 30, Carel van Bylandtlaan, The Hague.

Hydrogenation, destructive; catalytic materials.—A catalyst for use in the destructive hydrogenation of carbonaceous materials such as coal, brown coal, tar, mineral oils and their derivatives, cellulose, wood, and the like comprises simultaneously precipitated iron and aluminium oxides, which may contain water. An aqueous solution of aluminium chloride is mixed with a solution of ferric chloride in dilute hydrochloric acid and precipitated with excess of ammonia. The washed precipitate is dried at 150° C. until it contains 10-12 per cent. of water.

The Specification as open to inspection under Sect. 91 (3) (*a*) describes also the use of catalysts consisting of mixtures of two or more metals or metal compounds. This subject-matter does not appear in the Specification as accepted.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ANTOXA.

518,343.—Chemical substances for use in manufactures to prevent oxidation in fluids.—Cuxson, Gerrard & Co., Ltd., 26, *Fountain Lane*, Oldbury, Worcestershire. February 4th.

POLEFINAL.

518,779.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research and anti-corrosives. — I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany. February 4th.

GRAMMAR OF LOGIC.

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Surplus Books For Sale At Bargain Prices.

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SOME NOTES ON THE CINCHONA INDUSTRY.

BY BERNARD F. HOWARD.

(Vice-President of the Institute of Chemistry).

Streatfield Memorial Lecture delivered before the Institute of Chemistry and Past Students of Finsbury Technical College, at 30, Russell Square, London, on 21st November, 1930—Mr. Arthur Jenner Chapman, Vice-President, in the chair.

There is a tradition that the Indians of Peru were acquainted with the curative properties of the bark as early as the year 1500. This is mentioned by Ralph Irving in 1785 in his *Observations on Peruvian Bark*, the story that an Indian was cured of an ague after drinking water in which Cinchona trees had fallen owing to an earthquake. If this legend is true, it is obvious that the secret was carefully kept from the Spanish Conquerors, or it may even have been lost for a time, since a century elapsed before any record of a European cure. It must be remembered, however, that during this period, Peru was racked by the Spanish conquest and subsequent civil wars, and, consequently, it is not surprising that the discovery made no headway. It would be interesting for any student of Elizabethan times to conjecture how different might have been the history of the Spanish Main, had either of the rival forces been in possession of an efficient febrifuge. Weddell, in his *Histoire Naturelle des Quinquinas*, mentions that Jussieu records the cure of a Jesuit by Peruvian bark at Malacotas in 1600, and from that date allusions to the use of the bark become fairly frequent.

Three centuries ago, however, there was no press to boom a patent medicine, and it required a *cause célèbre* to force it upon the attention of the public. This was provided by the cure of the Countess of Chinchon in 1638, and few ladies of that day could have supplied such a good advertisement. This lady was seized with tertian fever, and news of the malady reached Canizares, who, having himself been cured by the bark, sent some to the Countess at Lima, who thereby effected a sensational cure of his distinguished patient. Shortly after her discovery, the Countess returned to Spain, bringing some of her bark, and, acting as a useful propagandist by administering the drug to the malaria-stricken peasants on her estate, she was primarily responsible for its introduction to Europe.

Linnaeus, in his botanical clasification of 1742, named the genus "Cinchona," being misinformed as to the correct title of the Countess, and, consequently, much confusion has arisen in the spelling. Although the spelling of Linnaeus has eventually prevailed, bitter regrets have been expressed by purists, and Sir Clements Markham throughout his book insists on the correct spelling, "Chincona." The controversy apparently raged for a century; an admirable resumé of the dispute was written by Daniel Hanbury in 1875, strongly urging the inadvisability of altering in any way the nomenclature of Linnaeus. For many years after the Countess' cure, the handling of the bark was entirely in the hands of the Jesuits, an unfortunate circumstance, as, for a time, it caused the entire Protestant community of Europe to ignore its properties. Mr. Pilcher very kindly brought to my notice an interesting allusion to another *cause célèbre* from *Seward's Anecdotes of Distinguished Persons*, London, 1798, under "*Sir John Tabor, Knt.*"

When Sir John went to Versailles to try the effects of the bark upon Louis the Fourteenth's only son, the Dauphin, who had been long ill of an intermitting fever, the physicians who were about the Prince did not "chuse" to permit him to prescribe to their Royal patient till they had asked him some medical questions; amongst others, they desired him to define what an intermitting fever was. He replied, "Gentlemen, it is a disease which I can cure, and which you cannot."

Louis, however, employed him to prescribe for his son, which he did with the usual success attendant upon the heaven-descended drug, which he administered.

It is interesting to note that Sir Clements Markham states that in 1679 Louis XIV bought the secret of preparing Quinquina from Sir Robert Talbor, an English doctor, for 2000 loius d'or, a large pension and a title. According to Sydenham, Sir Robert Talbor, who is also named John or Richard, or Tabor, according to whim of the writers of the day, used an infusion of Cinchona bark in port wine, and he can thus claim to be the first manufacture of "Extract. Cinchonæ Liq.P.B." Almost the last publication by the late Mr. E. M. Holmes (an article in the *Chemist and Druggist* of June 28th, 1930, entitled "Three Hundred Years of Cinchona") supplies some very interesting information about Sir Robert Talbor. Mr. Holmes found in the British Museum a book on Agues by Talbor published in 1672, the title page of which reads:

"PYRETOLOGIA.

a rational account of Cause and Cure of Agues, with their signes Diagnostic and Prognostic, with an account of the successful method of the author's for the cure of the most tedious and dangerous quartans, likewise some observations of cures performed by the aforesaid method.'

He states that Robert Talbor was appointed physician to Charles II in 1678, apparently having cured the King of a fever, and was knighted the same year, but died in 1681 at the age of 40.

It is not perhaps surprising that, prior to this, the efficacy of the bark was a matter of controversy when one considers the methods of administration current at the time. As the bark was apparently invariably administered in powder form, the febrifuge action would depend upon the power of the acids of the stomach to extract the alkaloids from it. In some instances, alkaloid solvents may have been given at the same time, since one enthusiast, in describing his cure, states that he took a teaspoonful of bark in a glass of claret every hour.

Mr. Pilcher has called my attention to two delightful extracts depicting the misgivings aroused by the use of Jesuits bark. The first is from *Evelyn's Diary*:

"29 November, 1694.—I visited the Marquiss of Normanby and had much discourse concerning King Charles II being poisoned.—Also concerning the Quinquina, which the physicians would not give to the King, at a time when in a dangerous ague it was the only thing that could cure him (out of envy because it had been brought into vogue by Mr. Tudor, an apothecary), till Dr. Short, to whom the King sent to know his opinion of it privately, he being reputed a Papist, (but who in truth a very honest Christian) sent word to the King that it was the only thing which could save his life, and then the King injoin'd his physicians to give it to him, which they did, and he recover'd Being asked by this Lord why they would not prescribe it, Dr. Lower said it would spoil their practice, or some such expression, and at last confessed it was a remedy fit only for Kings."

It is interesting to note that Evelyn himself was a Fellow of the Royal Society and a "Chymist" of some repute.

The second is from Ashton's *Social Life in the Reign of Queen Anne*, and describes a somewhat curious antidote for poinsoning by Jesuits' Powder:

"Quinine was then used for ague and fever, not as the crystal alkaloid, but in the rough bark, which was sold as 'Jesuits' Bark,' at prices ranging from 4s. to 10s. per lb." . . . "Quackery was rampant, probably because people did not have much belief in the healing powers of the regular practitioners. Herbs and simples were much in use; and not only were there fearful remedies concocted by fair hands in the still-room, but naturally every old woman had faith in the traditional medicaments handed down to her by her forefathers. Also the empiricism of the alchemists still lingered—see the following advertisement: 'Whereas the Viper hath been a Medicine approved by the Physicians of all Nations; there is now prepared the Volatile Spirit compound of it, a Preparation altogether new, not only exceeding all Volatiles and Cordials whatsoever, but all the Preparations of the Viper itself, being the Receipt of a late Eminent Physician, and prepar'd only by a Relation. It is the most Sovereign Remedy against all Faintings, Sweatings, Lowness of Spirits, Vapours, etc.—As also in all Habits of Body or Disorders proceeding from Intemperance, eating of Fruit, drinking of bad Wine, or any other poysonous or crude Liquors, and is good to take off the ill Effects or Remains of the Bark or Jesuits' Powder."

There is no doubt that malaria victims consumed enormous doses of the drug of which the alkaloid content may well have been extremely variable or even conspicuous by its absence, and of the total alkaloid content, only a small proportion can have the opportunity of exerting a definite therapeutic effect.

The method of collection (merely felling the tree and stripping its bark) was so wasteful as to cause scarcity of the trees, and towards the end of the eighteenth century, efforts were made by the Spanish Government, by means of botanical surveys of the forests of the Andes, to extend the area of the bark collectors. This was only a temporary palliative, and in spite of the warnings of Condamine, Weddell and others, the gradual extinction of the Cinchona forests of the Andes continued until 1852, when the era of transplantation and scientific cultivation commenced. While, on the one hand, the natural Cinchonas were being rapidly destroyed, on the other, the knowledge of the alkaloids present in the bark, had made great strides. Gomez, a Portuguese Naval surgeon, separated Cinchonine in 1810, followed in 1820 by the isolation of quinine by Pelletier and Cavantou. The isolation of the two remaining principal alkaloids, Cinchonidine and Quinidine, was the subject of fierce controversy owing to muddles in nomeclature, but by 1850 the "Big Four" were known and recognised. As a natural sequence of the isolation of these alkaloids, came their manufacture. I believe that the firm of Morson were the first manufacturers of quinine in this country. The records of my own firm show that my great-grandfather, Luke Howard, was making quinine in fairly large quantities in 1823, and by 1854 he was turning out 150,000 ounces a year.

There seems to be no doubt that following on his research work Pelletier's quinine was the earliest manufactured product.

In 1880 the Indian plantations gave every promise of becoming the main source of supply for the markets of the world. The fact that India does not find herself to-day in that fortunate position is shown in the following table.

SOURCES OF BARK SOLD IN EUROPE.

	In 1880.	*In* 1911.
Columbia	6,000,000 lbs.	
Bolivia, Peru		35,200 lbs.
Ecuador	960,000 lbs.	
India ...	1,170,000 lbs.	458,600 lbs.
Java ...	70,000 lbs.	19,778,000 lbs.
Jamaica	21,000 lbs.	nil
Africa ...	nil	25,400 lbs.

The explanation obviously rests on the rise of Java as the greatest Cinchona producer. The first cultivation in Java in 1852 ended in complete failure through the poor alkaloid-producing characteristics of the varieties of Cinchonas of which seedlings were secured from South America; the only trees producing a tolerable yield being a small number obtained from MacIvor's plantations in the Nilgiris. In 1855, however, Charles Ledger secured some seeds of Cinchona calisaya, half of which were planted in India and half in Java. Those in India failed, owing either to the climatic conditions or to mismanagement. Those in

Java flourished, and have produced a wonderful strain of strees, which, by skilful scientific cultivation, have produced bark containing up to 10 per cent. of quinine, and have, therefore, far suprassed any other variety in market value and utility.

To emphasise the effect of successful Java cultivation the table given below shows two analyses: A, typical of the very best natural Salisaya bark produced from wild trees in about 1865; and B, of a typical good qnality cultivated Legeriana bark in 1914:

	Quinine.	*Cinchonidine.*	*Quinidine.*	*Cinchonine*	*Amorphous*	*Total alkaloids.*
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
A	3.615	0.75	0.165	0.34	0.93	5.80
B	7.92	0.105	0.08	0.085	0.91	9.10

This shows the triumph of skilful cultivation in producing an enormous alkaloid yield of almost pure quinine, over the best unaided efforts of nature.

The rise in the quinine content of the average bark worked in the factory is also very signficant, and for this purpose I have taken the average test of one year's working in each decade.

1870	... 1.97	per	cent.	quinine
1880	... 1.59	,,	,,	,,
1890	... 2.47	,,	,,	,,
1900	... 2.57	,,	,,	,,
1910	... 3.16	,,	,,	,,
1920	... 3.90	,,	,,	,,
1929	... 4.93	,,	,,	,,

I have only dealt with Cinchona cultivation in India and Java; and although these are far the most important, they are, of course, by no means the only countries in which quinine has been cultivated. In a very brief resumé it is impossible to deal with many other interesting experiments in other parts of the world, but I venture to allude to one experiment which is of very great personal interest. John Elliot Howard, during his study of the Cinchonaceae, succeeded in growing some trees in his greenhouse at Tottenham; unfortunately long since destroyed.

The constituent alkaloids, all of which have been isolated from natural Cinchona barks ,number 30, and are shown in the following table grouped according to their empirical formulae:

1.	Cinchonine	
2.	Cinchonidine	$C_{19}H_{22}ON_2$
3.	Cinchonicine (cinchotoxin	
4.	Hydrocinchonine (cinchotine)	
5.	Hydrocinchonidine (cinchamidine)	$C_{19}H_{24}ON_2$
6.	Cinchonamine	
7.	Cupreine $C_{19}H_{22}O_2N_2$	
8.	Quinamine	
9.	Conquinamine	$C_{19}H_{24}O_2N_2$
10.	Quinine	
11.	Quinidine	$C_{20}H_{24}O_2N_2$
12.	Quinicine (quinotoxin)	
13.	Hydroquinine	
14.	Hydroquinidine	$C_{20}H_{26}O_2N_2$
15.	Chairamine	
16.	Conchairamine	$C_{22}H_{26}O_4N_2$
17.	Chairamidine	
18.	Conchairamidine	
19.	Aricine	
20.	Cusconine	$C_{23}H_{26}O_4N_2$
21.	Concusconine	
22.	Dicinchonicine $C_{38}H_{42}ON_4$	
23.	Diquinicine (diconquinine) $C_{40}H_{46}O_3N_4$	
24.	Javanine	
25.	Cusconidine	formulæ not determined
26.	Cuscamine	
27.	Cuscamidine	
28.	Paricine $C_{16}H_{18}ON_2$	
29.	Paytine	
[illegible]	[illegible]	[illegible]

These are combined in the bark mainly as quinates and cinchotannates with quinic acid $C_7H_{12}O_6$, and cinchotannic acid $C_{14}H_{16}O_9$; the former occurring to the extent of 5-8 per cent., and the latter 3-4 per cent. in the barks. Quinovic acid $C_{32}H_{48}O_6$ and oxalic acid (as the calcium salt) are also present in small amounts. The quinates are soluble in water, but the cinchotannates are only slightly soluble; dilute acids, however, decompose them and effect solution. The colouring matter in the bark is cinchona-red $C_{12}H_{14}O_7$, which occurs to an extent as great as 10 per cent. This is soluble in alkalis, being re-precipitated by acids. Two glucosides, *a*-quinovin and *b*-quinovin, are usually present in all Cinchonas, and give on hydrolysis quinovic acid and quinovose, a sugar isomeric with rhamnose. The neutral bodies, cinchocerotine, and the isomers, cupreol and cinchol ($C_{20}H_{34}O+H_2O$), together with cholestol, appear to be constant constituents of Cinchona barks.

Most of these alkaloids are more or less chemical curiosities, and the majority of them occur in extremely small quantities. Althongh each and all of them are undoubtedly interesting from an academic point of view, very few of them have, or are ever likely to have, any practical bearing on the Cinchona industry.

The uses of these alkaloids outside the field of medicine is surprisingly small. Certain of the amorphous alkaloids have been used to a small extent as accelerators in the vulcanisation of rubber, and one or two of the crystallisable alkaloids are said to have remarkable properties in the moth-proofing of furniture. In medicine an overwhelming proportion of the total production is used in malaria treatment, so that one can safely say that the industry exists to-day for one great purpose and one only, that of combating the scourge of malaria throughout the civilised world.

There are in the bark only four natural alkaloids of real commercial importance, *viz.*, the laevo-rotatory Quinine and Cinchonidine and the dextro-rotatory Quinidine and Cinchonine. The two amorphous substances, Quinicine and Cinchonicine, are also of some interest in that they are contained in considerable proportions in various types of febrifuges sold on the Indian market.

In 1867 a Royal Commission was set up to report on the comparative efficiency of the alkaloids in dealing with the Indian malaria problem. The summary of that report is somewhat ambiguous, but their respective value was placed in the following order:

1st. Quinine and Quinidine.
3rd. Cinchonidine.
4th. Cinchonine.

Medical opinion does not seem to have changed very much in the last 60 years, but Lt.-Col. Gage, in a paper before the Royal Society of Tropical Medicine in 1925, pointed out the value of the residual alkaloids in the form of febrifuge not as a substitute for quinine, but as an extension of its use in malarial countries. Some of the advocates of cheap febrifuge mixtures as a substitute for quinine appear to be under the impression that there are at present vast quantities of Cinchona products being utterly wasted which could well be utilised. As far as my experience goes, this is a fallacy, and I have no knowledge of the existence of any hoards of residual alkaloids in this country or any other part of the world.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

Applications for Licences in January, 1931.

The following statement relating to applications for licenses under the Dyestuffs (Import Regulation) Act, 1920, made during January has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 712, of which 570 were from merchants or importers. To these should be added 16 cases out-standing on the 31 December, 1930, making a total for the month of 728. These were dealt with as follows:—

Granted—660 (of which 605 were dealt with within 7 days of receipt).

Referred to British Makers of similar products—39 (of which 20 were dealt with within 7 days of receipt).

Outstanding on 31 January—29.

Of the total of 712 applications received, 625 or 86 per cent. were dealt with within 7 days of receipt.

THE ACETOLYSIS OF BAMBOO CELLULOSE.

By SUTEZO OGURI AND MASAAKI NARA.

The authors have studied the chemical properties of bamboo cellulose as compared with those of cotton cellulose by means of acetolysis. Cotton cellulose used in this experiment was prepared by the standard method proposed by the Committee of the Division of Cellulose Chemistry of the American Chemical Society. Bamboo celluloses were isolated by the chlorination method from ground Madake (Phyllostachys bambusoides) and Mosochiku, (Phyllostachys pubescens, H. Leh.) respectively, and then purified with 17.5 per cent. caustic soda solution.

Acetolysis experiments were carried out under nearly identical conditions. Two grams of air dried sample were put into a mixture of 8 grams of acetic anhydride (boiling point 135-137° C.) and two grams of sulphuric acid (sp. gr. 1.83) in a stoppered bottle. The mixture was cooled to -10° C. at such a rate that the temperature did not rise above 0° C. during the addition. The sample was pressed down so as to moisten the substance thoroughly, and the mixture was then allowed to stand for at least an hour holding the temperature below 10° C. Then the bottle was placed in a thermostat kept at 25 ± 0.03° C. for six days. To the crystalline mass in the bottle were added 12 cc. of glacial acetic acid and the mixture was warmed on a water bath (to a temperature not above 50° C:) until it could be poured from the bottle into 200 cc. of ice water. The bottle was rinsed with 50-80 cc. of ice water and the precipitate was allowed to stand for 30 minutes. It was then filtered off the cellobiose octacetate, dry at 100° C., and extracted with chloroform. After evaporation of the solvent the residue is crystallised from boiling alcohol. The filtrate was evaporated to 75 cc. and allowed to stand at room temperature in order to obtain a second crop of crystals. The yields are recorded in the following table.

TABLE I.

COMPARISON OF YIELD OF CELLOBIOSE OCTACETATE OBTAINED FROM COTTON AND BAMBOO CELLULOSES.

	Sample taken gr.	Cellulose in gr.	Cellobiose octacetate Obtained gr.	Cellobiose octacetate Yield %
Standard cotton cellulose	1.8214	1.7926	1.0354	27.60
,, ,, ,,	1.8107	1.7821	0.9041	24.24
,, ,, ,,	1.8579	1.8243	0.9224	24.16
Cellulose isolated from Madake	1.8685	1.6774	0.9016	25.68
,, ,, ,,	1.9323	1.7346	0.8916	24.56
Cellulose isolated from Mosochiku ...	1.8483	1.6149	0.8052	23.82

In order to ascertain whether the acetolysis products obtained from three kinds of cellulose are chemically identical or not, the authors determined the melting point and specific rotation of the products. On the determination of specific rotation the Hilger Industrial and Medical Polarimeter (M.194) and the Hilger Polarimeter (M2) were used.

The results were as follows :

TABLE II.

MELTING POINT OF CELLOBIOSE OCTACETATE.

Samples used for preparation of cellobiose octacetate	Standard cotton cellulose	Cellulose isolated from Mosochiku	Cellulose isolated from Madake
Melting point (C)	225.6	225.8	226.6

These figures were mean values of three times' observations. Thermometer employed on the determination of melting point was calibrated with a standard thermometer certified by P.T.R.

TABLE III.

Samples used for preparation of cellobiose octacetate	Standard cotton cellulose	Cellulose isolated from Mosochiku	Cellulose isolated from Madake
Specific rotation.	+41.70°	+41.94°	+41.20°

As shown in Tables I and II, the melting point and the specific rotation of the acetolysis products of the celluloses are nearly identical, so the celluloses isolated from bamboo stalks would be chemically identical with cotton cellulose if any other characteristic property, which makes a distinction between them, is not found. —Technical Chemical Laboratory, Waseda, University, Tokyo.

GEOLOGICAL FEATURES OF GREAT SLAVE LAKE.

A continuation of the investigation of the geology and mineral possibilities of an area around the east end of Great Slave Lake, Northwest Territories, during the summer of 1930, confirms earlier conclusions of Dr. C. H. Stockwell of the Dominion Department of Mines, Ottawa.

This area is underlain by Precambrian formations and in 1929, Dr. Stockwell found an interesting sequence of formations. He noted that the oldest rocks are quartzite, cherty limestone and sedimentary schists. These have been intruded by granite and granite gneiss forming extensive areas both north and south of the lake. Deposited unconformably on these old sedimentary and intrusive rocks is a younger sedimentary-volcanic series composed of quartzite, sandstone, greywacke, arkrose, slate, shale, argillite, iron formation, limestone, andesite, rhyolite and quartz porphyry. This series occurs in all attitudes from nearly flat lying to steeply dipping folds and is intruded locally by batholithic rocks with a composition approaching that of syenite. A still younger series of conglomerate and sandstone is deposited unconformably on all of these rocks. The youngest consolidated rock in the area is diabase in the form of dykes and sills with well developed columnar jointing and forming prominent topographical features.

A few stringers of chalcopyrite was noted in association with syenite and diabase and a shear zone in quartzite was found to be mineralised with quartz disseminated chalcopyrite. The sandstone has a few veins of barite and specularite. No mineral deposits of commerical importance are yet known to occur within the area.

Outside of this area and in Devonian dolomite near Fort Resolution in Great Slave lake is a mineral deposit which is attracting a considerable amount of interest at the present time. Galena, sphalerite and marcasite occur as replacement and cavity fillings in dolomite, the deposit being similar in general characteristics to the lead and zinc deposits of the Mississippi valley. Several outcrops of ore minerals have been found within an area 1,000 feet in width and almost a mile in length. The Northern Lead-Zinc Company, Limited, which owns the property, has dug a number of test pits, sunk four prospect shafts to shallow depths, put down 160 churn drill holes with at total footage of 16,000 feet, and in addition some diamond drilling has also been completed.

CANADIAN BANKING STATISTICS.

In the interpretation of Canadian banking statistics, the relations of Savings Deposits to Current Loans is significant, and an upward trend in the volume of Savings Deposits is an essential to a satisfactory money situation. From July, 1930, to the end of November, the latest date for which information is available, the total of notice or savings deposits in Canada showed a steady increase. From a peak of $1,526,000,000 in January, 1929, there had been a decline until the total for July last amounted to $1,402,000.000. The total savings deposits in Canada at the end of November amounted to $1,439,000,000.

THE BRITISH WOOD PRESERVING ASSOCIATION.

A meeting of the members of the British Wood Preserving Association was held in London on 28 January, 1931, when a lecture on "The Control of Insects harmful to Timber" was delivered by Dr. James Watson Munro, Professor of Entomology in the University of London, Sir James Calder being in the Chair. The lecture was illustrated by lantern slides.

Dr. Munro, after dealing briefly with the insects which attack standing timber in the forest, passed on to the group of beetles which attack timber between the forest and the manufacture of the finished timber, the most important of which are the Lyctus Beetles and the Death-Watch Beetles. He stated that the Lyctus had proved a serious enemy to the timber trade, and that in spite of the enormous amount of damage done by it in timber yards and buildings, architects and builders do not sufficiently appreciate its menace, and have given too little attention to the Lyctus problem.

Turning to the question of Insectitudes, Dr. Munro threw on the screen a table drawn up by the late Professor Lefroy to show what he believed to be the necessary qualities of a really good insecticide for use against the Death-Watch Beetles. In the first place, penetration was necessary; then came killing power and permanency, so that once having got rid of the pest, there should be no chance of the beetle again appearing in the building and getting a hold. The ideal insecticide should also fulfill the following conditions: —

Be deterrent to the beetle,
,, unchanging, chemically,
,, non-inflamable,
,, non-poisonous in application,
,, non-poisonous after application,
,, not a varnish solvent,
,, simple and cheap,
,, not smelly,
not produce toxic vapour,
be not corrosive to metal,
,, applicable as a liquid,
must not form dust, and
must not affect colour.

At the moment, there is not a known chemical substance which meets all these needs, and a considerable amount of empirical work has to be done, because we must have something to be going on with. At the same time, further study of the bettle's life-history must be carried out.

The question of Insecticides, Dr. Munro said, is very important, and one which is really deserving of the utmost consideration by the British Wood Preserving Association. The difficulty of finding an insecticide which can be thoroughly recommended is made the more difficult by the great variation in the reaction of insects to insecticides—at some stages they are highly resistant, at other stages resistance is comparatively low — and the Entomologists working in the laboratories have a very grave responsibility in recommending any particular insecticide. When you ask their opinion you are asking them practically to recommend or wholly to discard some commercial product. Adequate scientific tests are necessary before recommendations [illegible] made, and these tests cannot be material on which to make tests. When it is stated that in certain experiments no fewer than 5,000 eggs of a species of beetle are required before results can be obtained from which really scientific conclusions can be drawn, it is hard to realise the need of the laboratories for large supplies of living material. It sometimes happens that in the whole of a roof, on being cut up, there are found perhaps only three beetles and half a dozen grubs. Builders and architects could render valuable help in this research, by bringing to the notice of the Forest Prodncts Research Laboratory, Princes Risborough, cases of Death-Watch Beetle damage which they may come across.

The Secretary of the Association promised Dr. Munro that the Association would assist in obtaining information on insect-attack of timber in buildings, etc., from architects, builders and contractors, to whom a circular or questionnaire could be sent.

Among those who took part in the discussion which followed the lecture, were Mr. A. R. Powys, Secretary of the Society for the Protection of Ancient Buildings, and Mr. W. T. Sweett, of Messrs. Holland and Hannen and Cubitts, Ltd. Mr. Sweet confirmed, from the point of view a firm supplying timber for panelling and other interior decorations, the remarks of the lecturer as to the extreme urgency of the Lyctus problem.

GENERAL NOTES

SULPHUR INDEPENDENCE FOR CANADA.

Large quantities of sulphur are annually imported into Canada by pulp and paper manufacturers for use in the production of sulphite pulp, the value being estimated at about £1,000,000 per annum, in spite of the fact that immense quantities of sulphide minerals are being treated in connection with the production of copper and other metals.

A direct saving of more than £320,000 annually is likely should it be found practicable to secure the general adoption of the new Freeman burner for the extraction of sulphur from iron pyrites. The burner, which is the invention of Mr. Horace Freeman, of Shawinigian Falls, Quebec, is expected to give rise to an important new mining industry, as the pyrite used in the processes is found at numerous places in Canada. The new sulphur supply, which it is estimated will cost annually about £480,000, as compared with more than £800,000 now being spent by the newsprint mills on imported sulphur. In addition to the saving previously mentioned, hyproduct steam produced in the process will be worth approximately £30,000 to some of the mills at present purchasing coal for steam generation.

The by-product of the process, namely, iron oxide, will have a sales value estimated at £80,000, and will supply about one-eighth of the present iron requirements of Ontario and Quebec. A ready sale is anticipated for this by-product, as all of the iron ore now used by steel works in these provinces is imported. Canadian railways would also benefit in view of the fact that the hauling of pyrite would cost about £200,000 as compared with the £60,000 spent on the transportation of brimstone at the present time. In addition, freight rates on the iron oxide would reach £30,000.

The success of the experimental installation of the Freeman burner is expected to give a decided impetus to its general adoption. The first experiments were made at a newsprint mill on the St. Lawrence River, pyrite ore being brought from British Columbia via the Panama Canal at a considerable expense. In spite of the low freight rate charged for sulphur landed at St. Lawrence River ports, the mill was able to show savings amounting to $6 per ton of sulphur used.

GYPSUM, 1929.

The Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics at Ottawa reports that the production of gypsum from Canadian deposits during 1929 amounted to 1,211,689 tons valued at $3,345,696 as compared with the high record for the industry of 1,246,368 tons worth $3,743,648 set up in 1928. Gypsum quarried during 1929 totalled 1,225,728 tons of which quantity 248,000 tons or 20.2 per cent. was calcined in Canada.

The Canadian production was obtained from quarries in Hants, Inverness, and Victoria counties, N.S.; Albert and Victoria counties, N.B.; near Paris, Ontario; Gypsumville, Manitoba; and in the Fort Steele, Kamloops and Clinton mining divisions, B.C.

Approximately 92 per cent. of the Nova Scotia production was shipped as crude gypsum to the United States during 1929. Two plants were operated in this province for the calcining of gypsum. At Windsor, N.S., hardwall and selenite plasters were produced; these products were shipped to various points in the Maritime provinces and some as far west as Montreal; shipments were also made to Newfoundland and New Zealand. A plant at Iona, N.S., produced plaster of Paris, hardwall plaster, stucco and dental plaster; the Maritimes, Quebec, and Ontario provided the principal market for these products although some shipments were made to the United States and New Zealand.

The New Brunswick output consisted of a very pure quality gypsum produced from deposits at Hillsborough. Hardwall, finishing and dental plasters were produced at Hillsborough and marketed throughout Canada and in the United States. Finishing plasters were also exported to New Zealand, Australia, South Africa, and the British West Indies. In addition to these products, shipments of crude gypsum were made to the United States. Small shipments of land plaster were made from a quarry at Plaster Rock, N.B.

Ontario's production consisted of crude and calcined gypsum produced at Caledonia and Lythmore.

In Manitoba crude gypsum was obtained from deposits at Gypsumville, 170 miles

north of Winnipeg. This crude material was shipped to Winnipeg for processing.

The British Columbia production was extracted from quarries at Falkland, Mayook and Kelly Lake. Shipments from Mayook consisted of crude gypsum for use in the manufacture of cement. The Falkland gypsum was shipped to a gypsum product plant Port Mann. Gypsite was obtained from several deposits located near Kelly Lake, on the Pacific Great Eastern Railway.

Exports of crude gypsum during 1929 amounted to 893,445 tons; this tonnage was shipped to the United States. Ground gypsum and prepared wall plaster exported during the year totalled 7,938 tons and consisted of shipments principally to New Zealand, the United States, Newfoundland and Australia.

In addition to the plants classified as primary producers, five other plants were engaged in secondary or manufacturing operations. A plant at Montreal, Quebec, produced wallboard and hardwall plaster from Nova Scotia gypsum. Two plants, one at Caledonia and one at Paris in Ontario manufactured gypsum blocks, wallboard, wall coatings and insulex. Gypsum wallboard, blocks and tile were produced at Winnipeg. A plant at Fort Mann manufactured wall plasters, wallboard, blocks and insulex. The capital actually employed by these operators was $3,695,124. These plants provided employment for 459 employees whose earnings totalled $689,081. Products sold during the year were valued at $3,476,019.

TENANTS WIN FIGHT AGAINST COUNCIL HOUSE BAN.

Following the protest of Dr. C. Carpenter, President of the South Metropolitan Gas Company, against the unfair restrictions which some housing authorities are imposing on their tenants, the Scarborough Town Council has abandoned the idea of evicting a number of householders who had installed gas, contrary to regulations.

The Corporation, it is stated, owns the electricity undertaking, and the use of this form of power is twice as costly to consumers as gas. It was considered improbable that any judge wonld, in these circumstances, make an ejectment order.

" Tenants are already paying rents far in excess of those they would have to pay to a private landlord," said Councillor Kipling, urging that the ban on gas should be lifted. " One has always been led to believe that an Englishman's home is his castle. If this policy of restriction is adhered to, his home will become a prison."

GERMANY.

Exhibition of Pharmaceutical Goods.

The Commercial Counsellor to His Majesty's Embassy in Berlin reports that the " Kerckhoff Institute for Scientific Research (Kerckhoff Institute für wissenschaftliche Forschung und Forstbildung), of Bad Nauheim, is forming a balneogical and balneographical museum in the Institute, as well as a museum for pharmacotherapy of heart diseases, and that British health resorts and manufacturers of pharmaceutical products are invited to exhibit in these museums.

The institute for research on heart diseases will be opened in the next few weeks. Glass show cases 1.60 m. high and 0.46 m. wide are provided for the exhibits, which are required for the balneographical and pharmacotherapy museums by the 1 March, 1931, and which must be forwarded carriage paid and addressed " Kerkhoff-Institut, Abteilung Museum, Bad Nauheim." It is suggested that exhibits take the form of models, illustrations, etc., particularly details as to composition and effect of waters.

In regard to the museum for pharmacotherapy of heart diseases exhibits must be sent in by the 25 February, 1931, addressed as above. The exhibition is not intended to be a collection of medicines, showing the various types of packing, but rather the preparation and as far as possible the effects of such medicines, as well as any historical material with details of the inventor, invention and original publications concerning the product.

TRADE MISSION TO SOUTH AFRICA.

The Department of Overseas Trade has just published (through H.M. Stationery Office) the " Report of the U.K. Trade Mission to South Africa and Rhodesia " (Pp. 61. Price 1s.), which includes memoranda on trade in agricultural machinery, motor vehicles and on co-operative advertising. U.K. trade with South Africa has not kept pace with that done with competitors and the views of members of the mission indicating their suggested remedies are worthy of close attention.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

Friday, February 20.

The following papers were read :—

On the Velocity of Sound Waves in a Tube. By G. G. SHERRATT, B.A., AND J. H. AWBERRY, B.A., B.Sc., F.Inst.P., Physics Department, National Physical Laboratory, Teddington, Middlesex.

The apparent velocity of sound in a tube of diameter 2 cm. has been measured at temperatures up to 400° C. and with frequencies of from 3000 to 14000 cycles. The reduction in velocity below the free-air value is discussed, and the suggestion is put forward that this reduction, for a single tube and gas, depends on the wave-length rather than on the frequency. The theoretical expression found by Helmholtz and Kirchhoff for the reduction in velocity does not appear to be valid, at any rate for the conditions obtaining in these experiments. The method used by Dixon and by Partington and Shilling for correcting for the influence of the tube receives support from the present results.

The experiments reveal the complication which ensues when the wave-length falls below a certain multiple of the tube diameter.

The Tube Effect in Sound-Velocity Measurements. By P. S. H. HENRY, Coutts Trotter Student, the Laboratory of Physical Chemistry, Cambridge.

The modifications to Kirchhoff's formula required to take account of the finite thermal conductivity of the tube, slip between the gas and the walls, temperature-discontinuity between the gas and the walls, and absorption of energy by the walls, are calculated and found to be negligible. The effect of roughness of the walls is discussed, and the couclusion is drawn that the large tube-effects often found in practice are due to irregular motion of the gas. It is argued that the methods of correcting for the tube-effect used hitherto are unreliable. The effects of oscillation of the piston and of the gas hehind the piston are investigated and it is shown that these may become appreciable in some forms of apparatus. The yielding of a tube of elliptical cross-section is calculated, and is shown to have a negligible effect.

A Note on the Elimination of the β Wave-length from the Characteristic Radiation of Iron . By W. A. WOOD, M.Sc., Physics Department, National Physical Laboratory.

A practical method of eliminating the β wave-length from the characteristic K-radiation of iron is described. The method is based upon the selective absorption produced by a thin film of pure manganese which is obtained in the required form by electrodeposition upon aluminium foil.

THE GEOLOGICAL SOCIETY.

January 28.

The South-West Highland Sequence. By JOHN FREDERICK NORMAN GREEN, B.A., F.G.S.

In 1923, the following sequence was proposed for Islay :—

Dark chloritic slates.
Calcareous passage beds.
Grey limestone.
Black sandstone.
Arkoses with banks of nordmarkite-conglomerate.
(Line of erosion.)
Dolomitic flags.
Siliceo-argillaceous flags.
White quartzite with rusty cross-bedded films.
Slightly felspathic quartzite.
Pebbly quartzite.

This sequence runs through Jura, Scarba, and the Garvellachs, the quartzites, however, thinning out.

It is considered that the present succession near Ballachulish can be parallelled in detail with Islay. On attempting to apply the result to the neighbouring areas of Glencoe, Onich and Cuil Bay, it appears that the following amendmeuts to current views are involved :—

1. The Appin Phyllites and Cuil Bay Slates must be identical with the Leven Schists (siliceo-argillaceous flags).
2. The Appin Limestone must be identical with the ' cream-coloured edge of the Balluchulish Limestone ' (dolomitic flags).
3. The dark part of the Balluchulish Limestone must be distributed into two horizons; one corresponding to the grey limestone of Islay, the other a black limestone which comes in above the dolomitic flags and below the line of erosion.

The sequence about Tayvallich and Criuan is, when the ' Crinan Quartzite ' has been divided into arkoses, flags, true quartzite and conglomerates, comparable with the Islay sequence, allowance being made for a volcanic series near the line of erosion. The beds are followed up to the neighbourhood of Loch Awe, where the vol-

canic rocks replace part of the sequence, which is, however, complete in the neighbourhood of Kilchrenan. The Loch Avich slates and grits are correlated with the dark chloritic slates and higher beds in Islay.

Thus, the areas, Islay-Jura, Ballachulish-Appin, and Tayvallich-Loch Awe, are complex synclines of correlated rocks. Between these synclines appear grey calcareous phyllites. Between the phyllites and the flags or discontinuous quartzite occur shallow-water beds, composed essentially of quartzitic conglomerate and calcareous sandstone, *accompanies usually, but not always, by* black slate. These beds, which may be referred to as the 'Shore Series,' run north-east through Islay and Jura as the 'Jura Slates'; thence through many islands, and on the mainland, as the 'Easdale Slates.'

The conclusion is that the structure of the whole of the Dalradian rocks of this part of the South-West Highlands can be explained by the following sequence :—

Chloritic grits.
Chloritic slates.
Grey limestone.
Basal Beds. {Black slates, above or below arkoses, with banks of nordmarkite-conglomerate. Either may be absent.
(Line of erosion.)
Black limestone.
Dolomitic flags.
Siliceo-argillaceous flags.
White quartzite / Slightly felspathic quartzite } May thin out.
Shore series {Quartzitic conglomerate and calcitic sandstone, usually with black slate.
Grey calcareous phyllites.

THE OPTICAL SOCIETY.

A meeting of the Optical Society was held at the Imperial College of Science and Technology, South Kensington, on Thursday, February 12. The following papers were read :—

Modern Optical Glass as Exemplified by the List of the Parsons Optical Glass Co., dated September, 1926. By T. SMITH, M.A.

The optical positions (μv) of the glass types catalogues by the Parsons Optical Glass Company and the relations between the dispersions for several segments of the visible spectrum, are exhibited graphically. It is shown that a knowledge of the refractive indices of any glass for three wavelengths is sufficient to specify the index for the whole of the visible spectrum, and a knowledge of two indices is almost sufficient. In particular the partial dispersive ratios are almost functions (nearly linear functions) of v only. This implies that there are no glasses suitable for making apochromatic telescope objectives of large relative aperture.

The graphs show that the general standard of accuracy of the measured indices is high.

A new graphical method of interpolating refractive indices for glass is obtained.

On the Fixed Points of a Colorimetric System. By J. GUILD, A.R.C.S., F.R.A.S.

The paper discusses the significance of the constants which enter into the specification of colour of the trichromatic system, and suggests certain fundamental considerations of a meterological character which ought to govern the choice of such constants in a standard reference system.

Various proposals which have been put forward from time to time are discussed in the light of these considerations, and the basis of the system which has been adopted by the National Physical Laboratory is explained.

Demonstrations were given of the following :—

(1) The Moll Microphotometer.
(2) The Pulfrich Photometer.
(3) The Recording Microphotometer of the Cambridge Instrument Co., Ltd.

ROYAL INSTITUTION.

At a General Meeting of the Members of the Royal Institution held on February 2, Lord Eustace Percy, President, in the Chair, the thanks of the members were returned to the Trustees of the Pilgrim Trust for their donation of £16,000 to complete the Building Fund, and to Sir Robert Hadfield for his present of research apparatus. A bequest of £100 from the late Mr. W. H. Frizell, M.R.I., was reported. Miss Grace Freeth, H. H. The Maharaj-Rana of Jhalawar and Dr. J. M. Robertson were elected Members.

SOCIETY OF PUBLIC ANALYSTS.

February 4.

The following papers were read :—

The Solubility of Milk Powder — The Moisture Factor. By L. H. LAMPITT, D.Sc., F.I.C., AND J. H. BUSHILL, M.Sc., F.I.C.

The authors stress the complicated nature of the changes which take place when spray dried milk powder absorbs moisture. The freezing of the fat, whereby it is made available for solution in organic fat solvents, is one indication of the changes taking place above the "critical moisture content," a figure dependent upon the solids-not-fat. The authors trace the effect of time and temperature on the development of insolubility, and give analyses of the insoluble matter which is found to be mainly casein.

The Determination of the Hydroxyl Content of Organic Compounds: Estimation of Castor Oil. By S. Marks, M.Sc., A.I.C., and R. S. Morrell, Ph.D., F.I.C.

Peterson and West's modification of the method of Verley and Bölsing, in which the hydroxyl content is determined by treatment with acetic anhydride and pyridine, was found the most satisfactory method, and is particularly suitable for the estimation of castor oil.

The Determination of the Carboxyl and Aldehyde Content of Organic Compounds: Estimation of Phenylhydrazine. By S. Marks, M.Sc., A.I.C., and R. S. Morrell, Ph.D., F.I.C.

The most suitable method was found to be that of Ellis, in which the substance is treated with excess of phenylhydrazine, and the nitrogen evolved on treating the excess with Fehling's solution is collected and measured in a simple form of apparatus, an allowance being made for the benzene vapour.

Food Control in Holland. By A. Van Raalte, D.Sc., and J. Straub.

An account is given of the method of administering food control in Holland, which is based on legal standards arrived at in many instances by agreement between the directors of the Control Service and the large manufacturers. Not only foods, but also other commercial products such as toilet articles, wall paper, insecticides, etc., are subject to control. There is a right of inspection of premises where food is manufactured or sold, and this, coupled with intensive sampling, has reduced to 6.7 per cent. the percentage of samples falling below the standard. A list of the standards for the different foods and other articles is appended.

The Determination of Small Quantities of Methane. By H. R. Ambler, B.Sc., F.I.C.

A convenient and precise technique is described for determining small amounts of methane in gas mixtures. The hydrogen and carbon monoxide are oxidised by means of cupric oxide at about 300° C., the resulting carbon dioxide removed, and the methane determined by burning with oxygen in the presence of platinum wire at bright yellow heat, and measuring the carbon dioxide produced and the residual oxygen. The combustion of ethane gives different ratios of these gases.

The Fatty Acids and Component Glycerides of Indian Ghee. By R. Bhattacharya and T. P. Hilditch, D.Sc., F.I.C.

The analytical constants of two samples of buffalo ghee and two of cow ghee have been determined, and their fatty acids analysed by the method of fractional distillation previously devised by the authors. The two cow ghees gave figures falling within the limits previously recorded for English and New Zealand butter fats, but the buffalo ghees showed rather higher Reichert-Meissl and Kirschner values. They also contained more butyric and stearic acids than were found in cows' butter.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

At the Monthly Council Meeting on February 4, Mr. Dampier-Whetham reported Mr. Fred Smith's election as Chairman for the ensuing year. Correspondence had been read to the Committee which had passed between a member and the Secretary with regard to the working of the Fertilisers and Feeding Stuffs Act in Lancashire. A letter had also been read from Dr. Voelcker explaining the point at issue under the Act. As the member concerned signified his intention of calling upon the Secretary in the near future, the Committee decided that no action on their part was necessary at the moment. A list of the samples analysed for members by the Consulting Chemist during the months of December and January had been submitted.

Mr. Dampier-Whetham, in the absence of Mr. Smith, moved the adoption of the Report. He was sure that the members would all be sorry to know that Dr. Voelcker was ill, and would hope that he would soon be well and able to attend the meetings.

The President: I am sure that we all echo that wish.

The Report was adopted.

NOTICES OF BOOKS.

Annual Tables of Constant and Numerical Data, Chemical, Physical, Biological and Technological. Index to volumes of the First Series (1 to V, 1910-1922) compiled by G. Kravtzoff, 4-to pp. LXIII-382. Gauthier-Villars et Cie. Paris : McGraw-Hill Book Company, Inc., New York (1930). Price : Cloth, Frs. 400.

These comprehensive Annual Tables of Constants have now become an important collection of volumes into which, in spite of the care taken in classifying the various subjects, the location of any information was rather difficult. The Index to the First Series answers a real need and its publication will be welcomed by all users.

This Index is a work of an entirely new type, it contains :

(1) An analytical Index in four languages (English, French, German and Italian) being the amalgamation and re-arrangement of the different analytical tables contained in each of the five volumes. This general Index enables the reader to locate in the volumes the place of the chapter he is interested in.

(2) An alphabetical Index of all substances (animal, vegetable and mineral species, technical products, etc). Every time it was found necessary, English, German and Italian names have been introduced.

Furthermore, this Index contains all the names of the chemical substances for which formulæ would be difficult to remember by one not specialized in organic Chemistry. The names (e.g., Antipyrine) are followed by their formulæ so that the reader can find them in Part 3.

(3) A Formula Index containing all substances with definite chemical formulæ, systematically arranged according to their empirical formulæ.

In the Alphabetical Index as well as in the Formulæ Index, the reader finds, fully quoted, all numerical researches made on a substance and the corresponding information (volume, page) enabling a quick location of the date in the volumes.

In order to give an idea of the importance of this work, we would like to mention that the number of substances of all kinds classified in this Index is superior to 20,000.

This short account shows the valuable services, the great savings permitted through this work which compilation must have cost considerable labour.

Thus completed, the Annual Tables of Constants stand as a monumental reference work, useful to all dealing with research work, including chemists, physicians, biologists, engineers and others.

Chemistry for Matriculation. By G. H. Bailey, D.Sc., Ph.D., and H. W. Bausor, M.A., F.I.C. Third edition. Pp. viii + 448. London : University Tutorial Press, High Street, New Oxford Street, W.C. 1931. Price 7s. 6d.

The object of this work, now in its third edition, is to give the student a sound account of the principles and methods and relevant facts upon which the science is based. The treatment of the subject remains distinctly practical. The experiment is first carried out and then the inferences and conclusions are drawn. The order in which the subject matter is taken is that which experience has shown to be the most convenient and for its purpose this textbook leaves little to be desired.

The first book in English dealing with the Chemistry of the Terpenes, that is to say, with those substances which form the more important constituents of the essential oils of plants, has been written by Dr. J. L. Simonsen, and is entitled *The Terpenes.* The first volume, which deals with the simpler acyclic and monocyclic Terpenes and their derivatives, will be published shortly by the Cambridge University Press.

Heredity Optic Atrophy (Leber's Disease), by Dr. Julia Bell, being Part IV, volume II, of "The Treasury of Human Inheritance," will be published shortly by the Cambridge University Press. This book forms the twenty-sixth volume of the Eugenics Laboratory Memoirs issued by the Francis Galton Laboratory for National Eugenics, University of London.

In the *Chemisch Weekblad* for February 7, there is an interesting article (with summary in English) by Dr. Kreulen on the discovery of a stock of fuel of English origin in an unearthed glass factory. This was recently brought to light during excavations in Amsterdam. The glass house existed in 1615 and some of the bituminous English coal stored there has been preserved. A close study of the contemporary British coal mining industry and export trade shows that well over a quarter million tons were exported in 1609 from the north of England.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Wednesday, March 4, at 8 p.m.—(Ordinary Meeting).—" Safety in Factories." By Sir Gerald Bellhouse, C.B.E., H.M. Chief Inspector of Factories.

THE ROYAL INSTITUTION.

21, Albemarle Street, London, W.1.

Monday, March 2, at 5 p.m.—General Meeting.

Tuesday, March 3. at 5.15 p.m.—" Adhesion II." By Sir William Bragg, K.B.E., M.A., D.Sc., F.R.S., M.R.I.

Thursday, March 5, at 5.15 p.m.—" Ozone in the Upper Atmosphere and its Relation to Meteorology." By G. M. B. Dobson, D.Sc., F.R.S.

MANCHESTER CHEMICAL SOCIETIES.

Society of Dyers and Colourists, Society of Chemical Industry (Joint).

Friday, March 6, at 7 p.m. in the Engineers Club, 17, Albert Square. " The Action of Caustic Soda on Cellulose. By S. M. Neale, M.Sc.

UNIVERSITY OF LONDON.

Advanced Lectures in Metallurgy. A Course of four Lectures on " Hardness and Hardening," will be given at The Imperial College-Royal School of Mines, Prince Consort Road, S.W.7. By Dr. W. Rosenhain, F.R.S., at 5.30 p.m., on March 2, 9, 16 and 23, 1931.

Lecture I.—" Definition of Hardness and Measurement of Hardness. Indentation, scratch, abrasion and pendulum methods. Relation of Hardness to strength, resistance to Abrasion and other properties."

Lecture II.—" The production of Hardness. Hard and Soft States in same Substance. The Mechanism of ' softness ' or plasticity. Slip and twinning under plastic deformation. Hardening by cold working. Effects of lattice distortion. Effect of grain size, Hardening by precipitation. The Dispersion Theory of Hardening."

Lecture III.—" Hardening in Non-Ferrous Alloys and in Steel. Alloys of Aluminium and of Copper. Equilibra of the Iron-Carbon Alloys. The Dispersion theory of the hardening of Steel. Other theories of hardening steel."

Lecture IV.—" Surface Hardening and Hard Bodies. Carburisation of Steel. Nitrogent surface hardening. Mechanical surface hardening. Intrinsically hard bodies—the diamond. ' Stellite ' alloys, Tungesten Carbide—and their uses. Hardness at high temperature."

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.

Department of Pharmacology.

Tuesdays and Thursdays at 5 p.m. Third of a course of Six Public Lectures on Physical Properties and Chemical Structure of Drugs in relation to Pharmacological Action." By Mr. H. R. Ing, M.A.. D.Phil., and Mss W. M. Wright, M.A., Ph.D.

Lecture III.—March 3. " Narcotics."
Lecture IV.—March 5. " Sympathomimetic Amines."
Lecture V.—March 10. " Ammonium Bases."
Lecture VI.—March 12. " Drugs of the Tropane Group."

SOCIEY OF PUBLIC ANALYSTS.

The Annual General Meeting of the Society will be held on Wednesday, March 4, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1., at 8 p.m.

The Ordinary Monthly Meeting of the Society will be held immediately following the Annual General Meeting.

The following papers will be read in title only :—

(I) " The Investigation of Japanese Beeswax." By H. Ikuta.
(II) " The Deniges-Oliver Test for Morphine." By J. Bamford.

THE PHYSICAL SOCIETY.

Friday, March 6, at 5 p.m., at the Imperial College of Science, Imperial Institute Road, South Kensington. Ordinary Meeting.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

3,569.—I. G. Farbenindustrie Akt-Ges.—Manufacture of isocyanates. February 4.

3,827.—I. G. Farbenindustrie Akt.-Ges.—*Manufacture of acetic anhydride.* February 6.

3,848.—I. G. Farbenindustrie Akt.-Ges.—*Manufacture of dimethylol urea.* February 6.

3,851.—I. G. Farbenindustrie Akt.-Ges.—Maunfacture of N-substituted alkylene diamines. February 6.

Specifications Published.

342,551.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of 1-hydroxy-4-halogen-anthraquinone-2-sulphonic acids.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

MURAPASTE.

519,312.— Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. — Walter Carson and Sons, Grove Works, Lombard Road, Battersea, London, S.W.11. Febrnary 11. (Associated).

MINFOOD.

518,775.—*Chemical substances used for* agricultural, horticutural, veterinary, and sanitary purposes. — United Chemists' Association, Ltd., Ucal Works, Priory Court, London Road, Cheltenham. February 11.

517,761.—A circular label device bearing the monogram U.A.C., the letter C with an arrow across it, and the letter Y within a circle. Chemical substances used in manufactures, *photography, or philosophical re-*

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THOS. BOYCE,
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THE CHEMICAL NEWS

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Surplus Books For Sale At Bargain Prices.

A list of various Important Scientific Books for Sale at usually ***less than half published prices*** *will be sent on application to the Manager, Chemical News, Merton House, Salisbury Square, London, E.C.4.*

THE FERMENTATION INDUSTRIES FOR 1930.

By H. LLOYD HIND, B.Sc., F.I.C., AND F. E. DAY, B.Sc., F.I.C.

(Abstracted from the Report prepared for the Society of Chemical Industry and the Institute of Brewing.)

It was mentioned in 1928 that L. R. Bishop considered that, for any given variety of mature barley, the quantities of the three most important groups of nitrogen compounds in the grain were dependent only on the total nitrogen content and that variations in the relative proportions of the proteins in barleys of equal nitrogen content typified different varieties. He has now published data which bear out this generalisation.

In two varieties, Bishop has followed the distribution of the nitrogen between the salt-soluble, glutelin, and hordein forms during the development of the grain. By marking several thousand ears of growing barley, the anthers of which appeared on a certain day, and subsequently sampling from the marked ears, he obtained enough grain for analysis of uniform physiological age at various stages of development. These samples were submitted to his usual analysis for total, salt-soluble, and hordein nitrogen. The rate of entry of nitrogen into the grain is rapid at first and decreases later. That of carbohydrate takes place in a similar manner, and in consequence, the percentage of nitrogen in the grain varies only slightly during development. Since the weight of the individual corns is increasing throughout such an experiment, Bishop points out that the results should be expressed as nitrogen per 1,000 corns rather than as a percentage in order to have a constant basis for comparison.

Sets of curves obtained in the same manner from the developing barleys proved to agree closely with those from the corresponding mature barleys, the difference consisting in a slightly lower percentage of glutelin and higher proportion of salt-soluble nitrogen. These development samples had been dried at a low temperature as quickly and as soon as possible after collecting to avoid or check further change. After a lapse of several months the proportions of the protein fractions had changed slightly but significantly and the new proportions were in closer agreement with those occurring in the mature barleys. This maturation effect is regarded as the

settling down of the proteins to a definite equilibrium dependent only on the variety *and the total nitrogen.* Cytological evidence of this was obtained by staining the residual proteins after extracting the salt-soluble and the hordein nitrogen from sections of grain by methods similar to those used in the analysis. All three forms of nitrogen were seen to occur together, mainly in the outer layers of the endosperm, and none were segregated in different parts of the corn. Bishop therefore concludes that "development of the protein in the barley grain is essentially a synthesis of the simpler compounds which enter it up to a definite equilibrium point controlled only by the total nitrogen content and the variety," and that "the equilibrium between the proteins is probably an equilibrium within the cell in which they exist together." The final stages in the attainment of this equilibrium are so slow in dried grain that he considers it unsafe to study the regularities in the nitrogen distribution in grain less than a year old. These investigations constitute an important step in the elucidation of the changes which take place in barley after harvesting and influence the subsequent germination of the grain. Changes in the nitrogenous constituents of the barley may not be the most important factors in the gradually increasing germinative energy, but they cannot be lost sight of in any future study of the course of events during the storage of grain. The establishment of varietal characteristics in the relationships between the various proteins and the total nitrogen of barley is another point which may lead to important practical results.

The maltster prefers low-nitrogen barleys because they modify more readily and have a lower "malting loss," whilst the brewer knows that they give higher extracts and, he believes, bright and relatively stable beers. On the other hand, it has been suggested that such barleys may be deficient in enzymic activity, yeast-feeding material, and those nitrogenous substances which are mainly responsible for palate fulness and head retention. A rather remarkable instance of the superiority of high-nitrogen barley for brewing beer of a type in which the two last properties are particularly demanded was given by H. Stadler in describing some malting and brewing trials at a Munich brewery with a very hard and coarse Bavarian barley containing 2.54 per cent. of nitrogen, which would, according to modern standards, be regarded as totally unsuitable for brewing. Part of the barley was malted under normal flooring conditions with a maximum temperature of 67° F.; the remainder was germinated at considerably higher temperatures, rising to 78° F. The kilned malts were dark in colour, and 30-40 per cent. of the corns were more or less steely. Despite this, the dark lager beers produced were better than that brewed with a malt of apparently much higher quality, containing 1.74 per cent. of nitrogen. The highly nitrogenous malts saccharified more rapidly, and the beers had more palate fulness and roundness of flavour, that produced from the malt floored at the higher temperature being the best. It may not be economically possible to revert to malts of this type, approximating to those used many years ago, on account of the high malting loss and low extract yield, but the experiments do indicate that barleys with high nitrogen content are not necessarily unsuitable for brewing, and might with advantage be selected for beers of the dark, full drinking Munich type. Relatively high floor temperatures seem to be desirable in malting such barleys. Bishop's generalisation in regard to the dependence of the quantities of the three most important groups of nitrogen compounds in barley on the variety and total nitrogen content, together with his first communication on the course of the changes they undergo during malting, which was referred to in last year's Report, are early stages in a comprehensive study of the nitrogen in barley, malt, wort, and beer, designed to clear up the present vague idea of "quality" in barley and its relationship with the nitrogen content.

It is already possible quantitatively to connect certain factors in the brewing value of barley with the nitrogen content. Among such factors, that of available extract is of particular moment. From a statistical analysis of some of the results obtained for barleys and malts in the course of the Institute of Brewing Barley Research, Bishop has derived a formula which may be used to predict the extract which should be obtainable from any given sample of Plumage-Archer barley when malted under normal conditions. This formula is based on a knowledge of the nitrogen content, moisture, and thousand-corn weight of the barley and, with slight modification, can

be made applicable to other varieties. Similar slight modifications may be necessary to allow for different malting conditions, but, for uniform conditions, the standard error of the prediction is as low as ±0.8 lb. per quarter. The possible applications of such formulæ go far beyond the prediction of extract in connection with the valuation of barley. They may, with great advantage, be used in controlling malting operations. Thus it is possible to decide whether the extract obtained under conditions of malting is as high as can be demanded from the barley in question, or whether unexpected results are due to unsuspected variations in conditions on the floor or to variations in the bulk of barley wetted.

THE ACTIVE CONSTITUENTS OF HOPS.

The behaviour of the nitrogen of wort when boiled with hops is an important connecting link between the extraction of nitrogen from malt and its utilisation by yeast during fermentation. Denaturation and precipitation of proteins occur, but there has been a considerable amount of discussion on the extent to which this is influenced by the hops. Contradictory views have been held since the tannins of hops were investigated by Etti 55 years ago, and to a large extent interest in the tannins languished when it became apparent that the preservative substances in hops were to be sought elsewhere. Attention was mainly concentrated on this aspect of the value of hops after the general adoption of Pasteur's views on fermentation and infection and until the question of nitrogen in brewing came to the fore. Quite recently there has been a marked revival of interest in the tannins, connected very closely with the development of deposit-free bottled beer, and the realisation that they played a not inconsiderable part in the necessary removal of nitrogen from wort, and also in the formation of haze and deposit in the finished brilliant beer.

The Tannins.—C. Etti identified the tannin of hops as a pyrocatechol tannin. With it he found a phlobaphen derived from the tannin by dehydration and condensation, and, as is now known, also by oxidation. The tannin is a yellow-brown powder, readily soluble in water to a pale yellow-green solution. The phlobaphen is only slightly soluble to a reddish solution. Both form soluble salts with alkalis. Since his work no attempt seems to have been made to investigate the properties of the isolated substances, and for further information as to their properties we are indebted to results which have been obtained with hops.

Hayduck and Goldiner were the first to arrive at the conclusion not only that the phlobaphen was more effective than the tannin in removing protein during the boiling of wort, but also that the hops contribute an amount of nitrogen about equal to that removed. L. Briant and C. S. Meacham failed to extract much tannin from hops, and J. Heron stated that the amount of tannin in a sample of hops diminished with age. The latter statement is probably so far correct in that the tannin slowly oxidises to phlobaphen. In the case of Briant and Meacham's experiments the change apparently took place during extraction. On this assumption it must be supposed that the reason for A. C. Chapman's finding, that the amount of tannin does not decrease with the ageing of the hops, is that he extracted both tannin and phlobaphen, and that both were precipitated by the cinchonine used in his method for determining the tannin. It is certain that hops do not lose their power of assisting protein precipitation, though the latter evidence goes to show that this action is modified by age. Indeed, F. Schönfeld stated that owing to the change of tannin to phlobaphen, old hops give a better break than do new. He considered that the tannin substances affect the flavour of beer in the direction of harshness, and that both the tannin and resin of new hops render them likely to give harsh beers.

In his study of the nitrogen question in brewing, H. T. Brown confirmed the solubility of part of the nitrogenous constituents of hops in wort, and stated that whereas the wort precipitated by the hop tannin was not assimilable by yeast, about two-thirds of the soluble nitrogen compounds from the hops was assimilable. In 1913 H. Schjerning made a similar observation, and noted in addition that the precipitation was increased by oxidation. Though this result was observed, he did not differentiate between tannin and phlobaphen. About the same time, Brown showed that the production of hazes in beers was in all probability due to delayed separation of a protein-tannin complex. He also did not distinguish between hop tannin and phlobaphen.

It is of course possible that hop tannin is not a single substance but a mixture, or that it may contain a substance or substances intermediate between lupulo-tannin and phlobaphen. That at least two tannins are present was stated by A. Reichard, who distinguished them by the different colours they gave with iron salts, but he made no attempt further to differentiate them, and may have been confused by phobaphen. On the other hand, the presence of two readily soluble tannins might clear up some of the discrepancies noted in the earlier work.

The most comprehensive study of the subject was, perhaps, that of W. Windisch. It was mainly concerned with the coloration produced during wort boiling, and the influence of the tannin in this respect. The author showed that hops boiled with distilled water gave a pale green extract, whereas if the water contained calcium or magnesium bicarbonates the extract was reddish. This was due to the more ready oxidation of the tannin in relatively alkaline solutions. From such solutions the difficultly soluble calcium or magnesium salts of phlobaphen are absorbed on the carbonates precipitated by boiling, and these are thus coloured red. In worts brewed with carbonate waters the carbonate reacts with the primary potassium phosphate of the malt to form secondary potassium phosphate, which is sufficiently alkaline to form the soluble red potassium salt of phlobaphen. In this manner the wort colour becomes darker and redder. Further, the salts of neither tannin nor phlobaphen give precipitates with proteins, and hence any of these substances which remains in the wort, combined with metals, is liable to be liberated as the acidity increases during fermentation and storage to cause protein precipitation and consequent turbidity.

For some years after this the tannins of hops were little studied, and the few papers which appeared contained nothing new apart from modified analytical methods devised by A. R. Ling and D. R. Nanji, and by P. Menaul. About 1928, interest revived, and F. Emslander advanced the view that the tannins of hops varied in astringency and protein-precipitating or "tanning" power. In agreement with Schonfeld, he stated that the tannin of new hops is much stronger than that in old hops, and suggested that when the former are used the protein particles are rapidly "tanned" externally whereby the interior is protected against further adsorption of tannin, an excess of which remains in the wort and is liable to cause haze later. He stated that the most favourable reaction of wort for precipitation of the protein-tannin complex in the copper was p_H 4.5, which is on the acid side of general brewery conditions. R. H. Hopkins had found that the best break occurred in his experimental hopped worts when they had p_H between 5 and 5.5 at the commencement of boiling.

B. D. Hartong has developed a modification of Löwenthal's permanganate titration method for tannin estimation, using purified casein as the adsorbent. By the use of this method, at different stages of the brewing of a Pilsener beer from a 12 per cent. wort, he found that the unhopped wort already contained 0.0111 per cent. of tannins derived from the malt. Since the hops used represented an addition of 0.0080 per cent. the total in the hopped wort before boiling was 0.0191 per cent., which after boiling was reduced to 0.0166 per cent., and further fell to 0.0157 per cent. after fermentation, and to 0.0152 per cent. after the beer had been stored for $2\frac{1}{2}$ months. The large proportion of the total tannin claimed to be derived from the malt is surprising, as is also the fact that only 20 per cent. of it was removed during boiling, fermentation, and storage. Hartong considers that the whole of the tannin in wort is present as adsorption complexes with the proteins.

The nature of the protein brought down by tannin during boiling had been studied by Brown, Schjerning, and Windisch in their several researches already mentioned. The earlier workers attributed the reduction of wort nitrogen by the action of hop tannin in the copper to the precipitation of albuminoses (proteoses) and peptones, and Brown concluded that the separation of amorphous matter from a hot boiled wort was a physical expression of the solubility of the combination of protein and tannin in the hot wort, and of its partial deposition when this solubility was decreased by a lowering of the temperature.

Summarising the results obtained it may be concluded that phlobaphen is a more satisfactory precipitant in the copper than is the original tannin, since its complex with protein is less liable to remain in colloidal suspension. Its formation is promoted by vigorous boiling and consequent aeration,

which has the additional advantage of encouraging flocculation. To obtain the best results the reaction of the boiling worts should be in the neighbourhood of p_H 4.5 or 5, though oxidation of the tannin to phlobaphen would take place more readily at a more alkaline reaction. This, however, would be inclined to leave excessive phlobaphen as a salt in solution, which would not only darken the wort, but, on the acidity increasing during fermentation and storage of the beer, would result in the formation of haze. Excessive tannin or phlobaphen also imparts harshness to the flavour. The nitrogenous substances precipitated by hops, addition to those which separate from unhopped wort on boiling, are albumoses (proteoses) or peptones. The simpler nitrogen compounds are not affected.

With regard to the interaction of proteins and tannins or phlobaphens in beer, the majority of authors seem to have overlooked the great probability that the two groups of complexes exist in an adsorption equilibrium in which other colloidal matter such as silicic acid and calcium oxalate may also play a part. The circumstances which may cause part of such a system to aggregate as a visible haze are probably varied and complicated, and it is not to be expected that anything like a full explanation of the production of haze in beer will be readily obtained. At present it would seem best in practice to trust to such measures as would be expected to give as low a proportion as possible in the finished beer of both the more complex proteins and the more astringent tannins, and to avoid contamination with metals or such changes of reaction as are liable to favour protein precipitation or upset the equilibrium.

(*To be continued.*)

CREDIT SALES IN POLAND.

A memorandum on the subject of credit sales in Poland has been prepared in the Department of Overseas Trade from information furnished by the Commercial Secretary to H.M. Embassy at Warsaw.

Maufacturers and exporters of British goods desirous of obtaining a copy of the Memorandum should apply to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1 (quoting Reference 2603/3/1930).

ELECTROLYTIC PRODUCTION OF HYDROXIDES.

R. SAXON, B.Sc., F.C.S., MEM. SOC. CHEM. IND., MEM. AMER. CHEM. SOC.

COBALT.

Water submitted to electrolysis with a metal anode gives hydrogen at the cathode, and the hydroxide of the metal at the surface of the liquid. The current is of 240 volts, and the hydrogen comes off copiously, sufficiently fast to be tested inside 30 minutes. With cobalt and nickel standing in aqua regia in beakers it will be seen how slow the action of the acid mixture is on these metals. The cobalt tints the liquid a beautiful red but the nickel may stand a week without giving more than a faint green. Submitted however to electrolysis the action is immediate, using only water. The following takes place with cobalt :—

1. The liquid takes on a pale bluish tint.
2. A blue green scum floats on the surface in the cathode tube. This has a composition difficult to determine, but is probably $Co(OH)_3$.
3. Apple green scum not as blue nor as bright as 2.
4. Brown green scum.
5. Red brown flakes everywhere in liquid. This is the rose red hydroxide $Co(OH)_2$.
6. Brown and black masses of oxides Co_2O_3 and CoO fill the liquid.

As in the cases with copper and iron the processes reveals itself as one of reduction in the product. As iron gave the ferric, then the ferrous hydroxide, and copper the blue $Cu(OH)_2$, then the white CuOH, to be followed by the oxide and finally copper, so cobalt and nickel offer a series of hydroxides diminishing in hydroxil.

NICKEL.

Under similar conditions at practically the same speed as with cobalt the hydroxides are delivered ,appearing first at the surface of the water in the cathode tube, as follows :—

1. Apple green film in cathode tube. This has a higher hydroxil attachment than the compound $Ni(OH)_2$.
2. Russet umber green scum follows. This is mostly the compound $Ni(OH)_2$.
3. Black floating specks of Ni_2O_3 followed quickly by geen NiO.

The lowering of the valency of the elements in the intrusive stratum Fe, Co, Ni is evident from these experiments. Nickel has a decided preference for the diad

valency, Cobalt is undecided between the diad and triad valencies, whereas iron does decidedly favour the triad, as is evident in the "*rusting*" of its salts.

THE ABRASIVES INDUSTRY IN CANADA.

The abrasives industry in Canada includes two main divisions : (1) The Natural Abrasives Industry, covering the production of natural abrasives such as grindstones, pulpstones and scythestones, corundum, diatomite, volcanic dust, etc.; and (2) the Artificial Abrasives and Abrasive Products Industry, which covers the manufacture of silicon carbide, fused alumina, abrasive wheels, abrasive paper, etc.

Diatomite.—In 1929 deposits of diatomite were worked at East New Annan, Nova Scotia, and Quesnel, B.C., the total production during the twelve months being 429 tons valued at $10,330, as compared with 368 tons worth $8,960 in 1928.

Garnets.—Operatious in the Garnet industry in Canada during 1929 consisted of development work on deposits iu Beaudin, Joly and Trevet Townships, Quebec. A small experimental consignment was made from the Joly property during the year.

Grindstones, Pulpstones and Scythestones. The production of grindstones, pulpstones and scythestones from Canadian quarries during 1929 amounted to 1,947 tons valued at $106,354; in the preceding year shipments totalled 1,855 tons worth $100,960. Grindstones were obtained from Nova Scotia and New Brunswick; pulpstones from New Bruswick and British Columbia; and scythestones from New Brunswick.

Volcanic Dust. Volcanic dust is used for purposes similar to ground pumice, particularly in the manufacture of cleansers and scouring powders and in some instances as a substitute for fuller's earth in the refining of hard oils and fats. The Canadian market for volcanic dust is not large, nevertheless, only about 2 per cent. is supplied by the domestic product.

The extcusive beds of volcanic dust that occur near Waldeck, Saskatchewan, were first discovered in 1918. Consignments have been made from these deposits annually for the past six years. In 1929, production amounted to 300 tons valued at $6,00 as compared with 485 tons at $9,795 shipped in the preceding year.

PULVERISED FUEL FIRING.

A Notable Power Station Installation.

(By A Well Known Engineer).

Of great interest from the chemical engineering point of view are the contracts that have recently been placed for the new "Dunston B" power station of the Newcastle-on-Tyne Electric Supply Company, Ltd., designed for 300,000 K.W., with probable extension. The North East coast has always been an advanced area so far as power station practice is concerned alike for example as regards high steam pressures, the utilisation of blast furnace gas, and combined combustion and low temperature carbonisation. Essentially the main features of the new power station are to he high snperheat, medium steam pressures, extensive use of reheating between the stages of the turbines, and mechanical stoker and pulverised fuel firiug on the "unit" principle.

In this connection Clarke Chapman and Company. Ltd., Gateshead-ou-Tyne, are supplying 6 water tube boilers 625 lbs., pressure and 825°F. superheated steam temperature, each of 156,000 lbs. evaporation per hour, along with pulverised fuel equipment for 4 of the boliers, according to the latest designs of their "Resolutor" unit pulveriser. Much other equipment is also included, in their contract, while Babcock and Wilcox, Ltd., are to instal 6 combined boilers and steam reheater units, each of 125,000 lbs. of steam generation per hour (625 lbs. pressure and 825°F. along with mechanical stokers for 8 boilers, and C. A. Parsons and Company, Ltd., are making the turbo-generators, three units of 50,000 K.W. the present first section being 150,000 K.W.

Each of the 4 boilers will be operated by 2 standard "Resolutor" pulverisers of 5 tons of coal per hour capacity taking coal direct with 8-15 per cent moisture, and grinding equivalent to 75-80 per cent. through a 200-mesh screen, that is 10 tons of coal per boiler per hour, or 40 tons for the whole equipment of 8 pulverisers.

Extensive experience with the pulverised fuel firing of steam boilers, both on land and sea, including for example, the Luton and the Stepney Borough Council, as well as many types of metallurgical furnace, has already heen ohtained bv Clarke Chapman and Company, Ltd., and there has now been construeted "Resolutor" pulverisers of 10 tons per hour capacity. An important

feature of the design, as indicated, is that any kind of raw coal, irrespective of the moisture content, even up to 25 per cent. or over, it taken direct without pre-drying, the installation including a forced draught fan, high speed pulveriser disc with renewable hard chrome steel beaters, pulveriser chamber liners, also renewable and of chrome steel, and gravity separater to control continuously the size of the particles, driven by a variable speed electric motor, all on the same baseplate, constituting a neat and efficient self-contained arrangement with small floor space. Also heated *air from the boiler furnace is passed* through the coal in the pulveriser equal to about 25 per cent. of the air for combustion, which is discharged to the burners. In general the "unit" pulveriser is advancing at the expense of the "bin and feeder" system, as well as mechanical stoking, while notable progress also is being made in the field of the internally fired cylindrical boiler, both "Lancashire" and "Scotch" marine types, one of the best known vessels in the latter connection, being the S.S. "Berwindlea" the first British ship built entirely for pulverised fuel firing.

PROFESSOR ELLIOT SMITH ON THE EVOLUTION OF MAN.

In a lecture at Conway Hall on February 16th, Professor Elliott Smith still further elaborated his theory of evolution . He showed a new series of photographs and drawings of the Peking skulls which have just come from Professor Davidson Black in China. The projections bring out with absolute precision the distinctive attributes of *Sinanthropus* and provide reasons capable of expression in mathematical terms to justify its generic rank. There was now no room for doubt, he said, that Peking Man was the representative of a genuine genus distinct from all other members of the human family of which he was the most primitive and generalized member.

After emphasizing the evidences of simian likeness revealed by this consideration of the earliest men, the lecturer turned to the discnssiou of the problem of man's affinities *and pedigree. The* admission of man's resemblance to the apes was implicit in every attempt at zoological classification that had been made, as well as in the folk lore that grew up countless centuries ago in every country where apes were known. The identity of structure in men and apes was amazingly exact, and the reactions of the blood and the physiological and pathological reactions showed that it was not due to mere similarity, which might conceivably be the result of independent development, but was really evidence of close affinity and descent from common ancestors.

The anthropoid apes separated from the tailed monkeys at the end of the Eocene period soon after the first monkeys arrived in the Old World from their original home in America. Before the beginning of the *Tertiary period the Old World supplied the* New with lemuroid and tarsioid animals from which in their new environment monkeys were created. In the neighbourhood of Eastern Asia these earliest primates came from cretaceous tree-shrews and these in turn from the jumping-shrews, which were among the most primitive mammals. Hence it became possible to push back the ancestry of man towards a reptilian stage with perhaps greater precision and certainty than was at present posible in the case of any other mamal, not excluding even the horse.

INSTITUTE OF CHEMISTRY.

REPORT OF THE COUNCIL.

(1930—1931).

Submitted at the Fifty-third Annual General Meeting of the Institute, on Monday, 2 March. 1931..

1. The Roll of the Institute.

Since the publication of the last Report (31st January, 1930), the Council has elected 69 Fellows, of whom 64 were formerly Associates, and 289 Associates, of whom 90 were Registered Students. Three Fellows and 7 Associates have been re-elected.

142 new Students have been admitted.

The Council records with regret the death of 21 Fellows, 6 Associates and 1 Student.

The resignation of 4 Fellows, 31 Associates, and 34 Students have been accepted, and the names of 108 Associates and of 33 Students have been removed from the Register in accordance with the By-laws.

The Register at this date, 30th January, 1931, contains the names of 5847 members (1932 Fellows, 3915 Associates) and 701 Registered Students. The number of members has increased by 133 and of Students has decreased by 16.

METALLURGISTS TO VISIT AMERICA.

ATTRACTIVE PROGRAMME OF MEETINGS IN U.S.A. AND CANADA.

A detailed programme has been issued of the visit that is to be paid to America next year by the Institute of Metals and the Iron and Steel Institute. These two international bodies have been invited by the American Institute of Mining and Metallurgical Engineers to hold their respective autumn meetings in New York in September, 1932, the meetings to be followed by a tour in U.S.A. and Canada, in the course of which many cities and industrial plants will be visited.

The party, which is expected to number about one hundred European members, will leave Southampton on board a Cunarder on Saturday, September 3, 1932, and is due to arrive a week later in New York, there to be joined by a contingent of American Members, expected to number about 200. After a week-end spent sight-seeing in New York, morning technical sessions will be held on September 12-13 in the Engineering Societies' Building, with local excursions to metal workers each afternoon. September 14 will be devoted to an all day trip to the Works of the American Brass Company at Waterbury. On the following day the party will proceed to Bethlehem, Pa., to visit the famous steel works and then return to New York in readiness for a mid-night start to Washington. Two days will be spent in the capital—with visits to the Bureau of Standards, Mount Vernon and other points of interest—and on September 17, Pittsburgh will be reached. Here the week-end will be spent visiting the University, the Mellon Institute, the Carnegie Institute of Technology, steel works and aluminium works.

Leaving Pittsburgh early on September 20, most of the day will be spent visiting plants at Youngstown, followed by a night run to Detroit. Here three strenuous days will be passed. Members of the two visiting Institutes will have the great advantage of being able to take part in the visit to the Exposition and technical sessions arranged by the National Metal Association, then holding its annual Convention in Detroit, followed by a dinner given by the American Society for Steel Treating. They will also see some of the great motor plants for which Detroit is world famous. On September 28 the Institute's party leaves for Cleveland where works' visits will be made during the afternoon, followed by departure for Chicago at midnight. Here the last week-end of the tour—now at its westward turning point—will be spent. Saturday, September 24, will be devoted to visits to steel and metal plants in the daytime, with a reception in the evening. The following day will be passed quietly, Niagara being reached the next morning. After a visit to the Falls and neighbouring works on September 26, the party will proceed to Hamilton and Toronto the next day. Many interesting visits will be paid in these two cities and also in Montreal and Quebec, whence the homeward bound liner will leave on September 30, being due at Southampton on October 8.

Such, in outline, is the programme of an ambitious endeavour. It represents the first combined trip ever arranged by the two institutes, and is expected to prove very attractive. Already nearly 100 Members have indicated their intention of travelling from European starting points, these including Stockholm, Moscow, Prague, Berlin and Rome. The cost of the trip—estimated at the reasonable figure of £125—can be met in advance by means of an "instalment plan," in accordance with which intending participants pay £7 per month to the bankers of the Institute of Metals, interest being allowed upon their deposits, which are returnable in the event of non-participation. Full particulars of this plan and of the American trip generally can be obtained on application to Mr. G. Shaw Scott, M.Sc., Secretary of the Institute of Metals, 36 Victoria Street, London, S.W.1. It is possible for eligible non-Members to join either Institute in time to take part in the trip to America.

CUBAN CONSULAR INVOICE FEE.

The Board of Trade understand that, as from February 1, the fee charged by Cuban Consular officers for the legislation of invoices of goods shipped to Cuba is at the rate of 2 per cent. *ad valorem.*

Hitherto the fee has been :—

For shipments valne up to 4.99 dollars—10 cents.

For shipments value 5 to 49.99 dollars—50 cents.

For shipments value 50 to 200 dollars—2 dollars.

For shipments value over 200 dollars—25 cents for every additional 100 dollars (or fraction of that amount).

GENERAL NOTES

STATUTORY RULES AND ORDERS AFFECTING THE CHEMICAL INDUSTRY.

That useful body, the Association of British Chemical Manufacturers, has prepared an Index to Acts of Parliament, and Statutory Rules and Orders affecting the chemical industry, which besides being unique cannot fail to prove both interesting and in many respects helpful to the great and widespread industry in whose interest it has been issued. Page 6, which we print herewith, will give a fair idea of the nature and scope of the work, which extends to 24 pages. The price of the book is 2s., and it is published by W. Heffer & Sons, Ltd., Cambridge.

ALKALI, ETC., WORKS REGULATION ACTS, 1906 and 1926 (Ministry of Health).
S.R. & O., 1906, No. 884.—Registration of Works Order, 1906.
S.R. & O., 1928, No. 26.—Alkali, etc., Works Order, 1928, extending list of noxious gases.

ALKALOIDS. *See* Dangerous Drugs, Poison.

AMMONIA.
Poisons & Pharmacy Acts, 1868-1908 (Home Office).
S.R. & O., 1911, No. 664.—Liquid preparations containing more than 5% by weight of free ammonia to be labelled.

ARSENIC.
Arsenic Act, 1851 (Home Office).
Factory & Workshop Acts, 1891-1901 (Home Office).
S.R. & O., 1892 (9th May).—Extraction of arsenic certified as a process dangerous or injurious to health.
Poisons & Pharmacy Act, 1868-1908 (Home Office).
S.R. & O., 1926, No. 86.—Arsenic scheduled as a poison, under Part I of Schedule, except as insecticide subject to certain conditions of sale.

BARIUM.
Poisons & Pharmacy Acts, 1868-1908 (Home Office).
S.R. & O., 1925, No. 198.—Adding salts, except sulphate, to Part II of Schedule.

BENZENE.
Factory & Workshop Acts, 1901-1920 (Home Office).
S.R. & O., 1915, No. 1170.—Notification of cases of toxic jaundice due to nitro- or amido- derivatives of benzene.
S.R. & O., 1922, No. 329. — Benzene solutions in indiarubber manufacture.
S.R. & O., 1924, No. 1505.—Notification of cases of toxic jaundice due to chronic benzene poisoning.

BICHROMATES.
Factory & Workshop Acts, 1901-1920 (Home Office).
Police, Factories, etc. (Miscellaneous Provisions) Act, 1916 (Home Office).
S.R. & O., 1918, No. 368.—Bichromates used for tanning.
S.R. & O., 1918, No. 369.—Bichromates used for dyeing.
S.R. & O., 1930, No. 312.—Bichromates used for tanning.

GIBBONS BROTHERS LIMITED.

Messrs. Gibbons Brothers, Limited, Dibdale Works, Dudley, in conjunction with Messrs. Wild-Barfield Electric Furnaces, Ltd., Elecfurn Works, North Road, Holloway, London, N.7., have acquired from Messrs. Rudge-Whitworth, Ltd., Birmingham, as from the 1st inst. the sole manufacturing and selling rights of the well-known Carburising Compound "Eternite."

We understand that Messrs. Gibbons Brothers, Ltd., and Messrs. Wild-Barfield Electric Furnaces, Ltd., are forming a new Company under the title of :—

G.W.B. ELECTRIC FURNACES LIMITED.

AUSTRALIAN TRADE IN NOVEMBER, 1930.

In November last, exports were £3,165,572 in excess of imports, as compared with an excess of imports of £521,254 during the corresponding month of 1929. For the first five months of 1930-31 (July-November) there was an excess of exports of £8,086,610 as compared with an excess of imports amounting to £16,455,140 for the first five months of 1929-30.

BRITISH IRON AND STEEL OUTPUT IN JANUARY.

Production of pig iron in January amounted to 327,200 tons, as against 349,800 tons in December, and 650,000 tons in January, 1930. Furnaces in blast at the end of January numbered 88, a net increase of seven since the beginning of the month.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, February 19.

The following papers were read :—

The Discontinuous Nature of the Process or Sorption of Gases and Vapours by Porous Solids. By A. J. ALLMAND, F.R.S., AND L. J. BURRAGE.

A brief summary is given of already published and some unpublished results, obtained either at low pressures or by a new "retentivity" technique, indicating the presence of discontinuities in the adsorption isothermals and isosteres of vapours on charcoal. A whole variety of charcoals, and three vapours, *viz.*, water, carbon tetrachloride and carbon bisulphide, were used.

The technique is described of a simple static method for the determination of adsorption isothermals, which permits of the detailed examination of a limited pressure range being rapidly carried out. The results of such measurements involving four charcoals (steam-activated soft-wood and nutshell, chemically activated soft-wood, and sugar charcoals), five vapours (carbon bisulphide, carbon tetrachloride, benzene, water, and *n*-amyl alcohol) and one gas (carbon dioxide, below and above its critical temperature) are communicated. Breaks in the iso-thermals were found in all cases.

Measurements with silica gel and with benzene, carbon tetrachloride and water also showed discontinuities, rudimentary or slight in the first two cases, but very pronounced with water.

Recent similar results published elsewhere are summarised, involving permanent gases, condensible gases and vapours; charcoal and finely divided nickel; measurements of adsorption isotherms, heats of adsorption and magnetic susceptibilty; very low to very high pressures.

A view of the mechanism of the adsorption process is outlined which has features in common with Polanyi's modified theory and with recent suggestions of Semenoff. Distinctions are made between the behaviour (*a*) of activated charcoal and of silica gel and (*b*) of water (molecules natural dipoles) and of carbon tetrachloride (molecules without dipole moment).

The Decay Constant of Uranium II. By C. H. COLLIE. Communicated by F. A Lindemann, F.R.S.

The following papers were read in title only :—

The Photo-Elastic Dispersion of Vitreous Silica. By L. N. G. FILON, F.R.S., AND F. C. HARRIS.

Observations of the double-refraction due to stress in specimens of pure vitreous silica by the spectrometer method described by one of the authors in 1903 showed certain characteristic local variations which turned out to be identical with local irregularities already found in boro-potassium-silicate glasses in 1907, showing that these irregularities were probably due to silica. A new method, based on the same principle, was devised, which avoided certain defects inherent in the older procedure and enabled the double refraction to be measured more accurately for a series of well-determined wave-lengths, the load on the specimen remaining unaltered throughout each set of observations.

The results have shown : (1) that the law of photo-elastic dispersion in silica varies slightly with the load applied, so that the usual assumption that the double-refraction is proportional to the stress cannot in this case be exactly true; (2) that the curve of photo-elastic dispersion shows marked and highly localised oscillations, which appear to have been partly masked by the method of observation hitherto employed: (3) that these oscillations are very probably due to some natural periods of the molecules, acting in a manner analogous to that which produces ordinary anomalous dispersion in the neighbourhood of an absorption band; (4) that although it is not possible as yet to identify these natural periods, the results do not negative the hypothesis that they agree with the known periods of the silicon spectrum.

Examples of the Uncertainty Principle. By C. G. DARWIN, F.R.S.

It is shown how observations with electrometers and magnetometers conform to the Uncertainty Principle of Heisenberg.

The Study of the Magnetic Properties of Matter in Strong Magnetic Fields. I, II. By P. KAPITZA, F.R.S.

Some Investigations in Röntgen Spectra. By G. B. DEODHAR. Communicated by O. W. Richardson, F.R.S.

Part I :—The $K\alpha$ and $K\beta$ groups of the elements : silicon, phosphorus, sulphur and chlorine are studied. New lines are observed and measured. Their possible origin is discussed.

Various hypotheses regarding the origin of X-ray spark lines have been examined.

The probability of the $L\gamma'_{23}$ line of Druyresteyn as resulting from the double jump NIV→MII and MII→LI or as a forbidden direct transition NIV→LI is demonstrated.

Part II :—A large number of sulphur compounds are examined, and it is found that considerable changes in the relative intensities of the β_1 and β_x lines take place from substance to substance.

The β_3 line listed by Hjalmar is suppressed by pure sulphur and some of its compounds whilst it is given out by some others.

Some new faint lines have been observed.

It has been observed that for the compounds Ag_2 S and Ag_2 SO_4 considerable changes in the wavelength and intensity relations of the β_1 and β_x lines take place on changing the anticathode material from copper to silver.

It is suggested that the β_3, β_4, β_5 and β_6 lines may possibly belong to a class of X-ray lines resulting from electronic transitions within a molecule.

Part III :—The fine structure of the K-edge of SiO_2 is recorded and measured by using quartz as the analysing and absorbing substance. The results obtained are not explanable by the existing hypotheses and it is suggested that the observed fine structure may result from the ejected K-electron stopping in one of the possible virtual electron orbits in the SiO_2 molecule. The possibility of such transitions in a molecule other than this has already been suggested in connection with the emission of the β_3, β_4, β_5 and β_6 lines by some sulphur compounds.

The Photosensitised Decomposition of Nitrogen Tetrachloride. By J. G. A. GRIFFITHS AND R. W. G. NORRISH. Communicated by T. M. Lowry, F.R.S.

On the Variability of the Quiet-Day Diurnal Magnetic Variations. II. By S. CHAPMAN, F.R.S., AND J. M. STAGG.

The Solution of the Torsion Problem for Circular Shafts of Varying Radius. By A. THOM AND J. ORR. Communicated by R. V. Southwell, F.R.S.

The Elastic Scattering of Slow Electrons in Argon. By E. C. BULLARD AND H. S. W. MASSEY. Communicated by Lord Rutherford, F.R.S.

The Magnetic Susceptibility of Binary Systems of Organic Liquids. By V. C. G. TREW AND J. F. SPENCER. Communicated by W. Wilson, F.R.S.

On the Thermal Conductivity of Some Metal Wires. By W. G. KANNULUIK. Communicated by Lord Rutherford, F.R.S.

THE CHEMICAL SOCIETY.

Thursday, February 19.

A New Method for the Preparation of Organo-Thallium Halides. By F. CHALLENGER AND B. PARKER.

It was shown by Michaelis and Becker (*Ber.*, 1882, xv, 182) that phenylboric acid and mercuric chloride react in hot aqueous solution, phenyl mercury chloride being precipitated.

$$PhB(OH)_2+HgCl_2+HOH=PhHgCl+B(OH)_3+HCl$$

In the course of a systematic study of the mobility of alkyl and aryl radicals when attached to boron (Ainley and Challenger, *J.*, 1930, 2171) the behaviour of phenylboric acid towards the thallium trihalides has been investigated. The close relation of thallium to mercury and the insolubility and stability to water of diphenyl thallium halides suggested that an analogous phenylation of the thallinm halides might occur. On the other hand, Ainley and one of us (*loc. cit.*) found that no organo-cadmium halides could be obtained from phenylboric acid and cadmium chloride or bromide. The product was benzene, probably due to the instability of phenyl cadmium halides to water.

Thallic chloride and bromide readily react in aqueous solution with phenylboric acid giving, according to the molecular proportions employed, diphenyl thallium chloride and bromide, *phenyl thallium dichloride*, m.p. 235°, and *phenyl thallium dibromide*, m.p. 153° (decomp.). Compounds of the type $RTlX_2$ do not appear to have been described.

The dihalides are decomposed by heating with water, the bromide very readily, thus

$$2PhTlX_2=Ph_2TlX+TlX_3.$$

The presence of phenyl thallium dihalides has also been detected in the pyridine mother-liquors obtained during the crystallisation of the product of the interaction of magnesium phenyl bromide and ethereal thallic chloride.

With potassium iodide phenyl thallium dichloride or dibromide gives an immediate yellow precipitate which quickly turns black, eliminating iodobenzene. Diphenylthallium iodide appears to decompose in

two directions, thus: $5PhTlI_2 = 5PhI + 5TlI$; $2PhTlI_2 = Ph_2TlI + TlI_3$.

The black precipitate is the compound $5TlI,TlI_3$ described by Jörgensen (*J. pr. Chem.*, 1872, VI, 82). It gives up iodine to potassium iodide, and this has been determined by thiosulphate titration. Phenyl thiocyanate and selenocyanate are similarly eliminated, using the corresponding potassium salts. Potassium bromide gave no bromobenzene. This recalls the stability of the dichloride and dibromide of triphenylbismuthine and the instability of the corresponding thiocyanate, iodide, and selenocyanate.

The Dissociation of Salts in Nitrobenzene. By W. F. K. Wynne-Jones.

From measurements of the electrical conductivity of nitrobenzene solutions of partially substituted ammonium salts such as piperidine picrate, it is shown that these salts are weak electrolytes. In explanation of their behaviour it is suggested that the hydrogen atom which is directly attached to the central nitrogen atom is also co-valently linked to the anion and that ionisation is aided by solvation of the ammonium ion. Evidence in favour of this view is adduced from Walden's data for the conductivity of salts of this type in a number of solvents.

The behaviour of these salts has important consequences for the study of acids and bases in different solvents.

The Direct Interchange of Chlorine in the Interaction of p-Toluenesulphonamide and N-Chloroacetanilide. By D. R. Pryde and F. G. Soper.

The rates of hydrolysis of *N*-chloroacetanilide and of *p*-toluenesulphonmonochloroamide into hypochlorous acid permit of distinguishing between these substances in solution. In the presence of phenol, which reacts with hypochlorous acid as produced, the amount of *N*-chloroacetanilide hydrolysing in 4 hrs. is inappreciable, whilst *p*-toluenesulphonmonochloroamide is half hydrolysed in 6-7 mins. On mixing aqueous solutions of *p*-toluenesulphonamide and *N*-chloroacetanilide, a bimolecular interchange of chlorine occurs ($k^{25} = 0.47$ mols./min.), until the respective hydrolysis constants are satisfied. This interaction cannot be explained in terms of a preliminary hydrolysis into hypochlorous acid as the formation of *p*-toluenesulphonmonochloroamide is several hundred times faster than the latter.

The Formation of Acyl-chloroamines from Hypochlorous Acid. By D. R. Pryde and F. G. Soper.

The general method of preparation of chloroamines from anilides using potassium hypochlorite in the presence of bicarbonate, avoids the simultaneous nuclear chlorination of the anilide, unlike chlorination by chlorine where *N*- and *C*-chloroderivatives are produced by side reactions. The rate of *N*-chlorination using anilides and hypochlorous acid is found to be proportional to the hydroxyl-ion concentration over the range, p_H 5.7—6.2, examined. The effect of the hydroxyl ion is shown to be on the hypochlorous acid rather than on the anilide, and hypochlorite ions thus appear to be the chlorinating agent. This is in contrast to the chlorination of phenols by hypochlorous acid.

GEOLOGICAL SOCIETY OF LONDON.

February 11.

Prof. E. J. Garwood, M.A., Sc.D., F.R.S., President, in the Chair.

The following communications were read:

The Upper Great Oolite, Bradford Beds, and Forest Marble of South Oxfordshire, and the Succession of Gastropod Faunas in the Great Oolite. By William Joscelyn Arkell, M.A., B.Sc., Ph.D., F.G.S.

In the first part of the paper the principal exposures in South Oxfordshire of the uppermost beds of the Great Oolite and the Forest Marble are described, with especial reference to the palæontological horizons, and for the first time the fauna of the highest portion (or Block I) of the Great Oolite is enumerated and discussed. It is shown that this fauna is essentially a Great Oolite one, and that the recent contention that the beds yielding it are younger than the Bradford Clay cannot be sustained.

Secondly, it is demonstrated that the renowned fossil bed of Islip, which follows next in the geological sequence and was spoken of as Bradfordian by such authorities as Lycett and H. B. Woodward as long ago as 1863, contains nearly the whole of the highly-characteristic assemblage of the Bradford Clay, of which it is held to be true representative. The doubts thrown on the validity of this rich assemblage as an indication of horizon are held to be without foundation, and the brachiopod which has been recorded below it as *Epithyris marmorea* (Oppel) and has been taken to indi-

Forest Marble of Wiltshire, is shown to have been mis-identified.

On these and various other grounds, both palæontological and stratigraphical, the recent great expansion of the Forest Marble at the expense of the Great Oolite is not accepted, and the original classification of Edward Hull (1859), adopted with varying amendments by A. H. Green (1864), H. B. Woodward (1894), T. I. Pocock (1908), and M. Odling (1913) is supported.

On the other hand, it is shown that, while the true Forest Marble in Oxfordshire is very thin (0 to 12ft.), the beds beneath the Bradfordian fossil bed often take on a facies which is difficult to distinguish lithologically from the Forest Marble, and that they thicken in the western part of the county to some 20 feet. These are the so-called 'unfossiliferous Cream-Cheese Beds' of Messrs. Barrow and Odling, and they are here correlated with the Kemble Beds of Gloucestershire, which have always been recognised to be older than the Bradford Clay (and, therefore, part of the Great Oolite).

For the true Forest Marble the name Wychwood Beds is advocated, to distinguish them from the Kemble Beds where those develop a similar facies.

A marked plane of erosion, often associated with pebbles and a non-sequence, is traced at the base of the Kemble Beds, as well as another at the base of Block I of the Great Oolite.

In the second part of the paper the gastropod beds of the Great Oolite are studied, and an attempt is made to disentangle the various species and genera. The indiscriminate past records of *Nerinea eudesi* are shown to cover not only that species but several new gastropods of the foldless genus *Aphanoptyxis*, which can be demonstrated to form definite zones of at least local utility in field work. The gastropod zones have been found to be distributed more consistently than the brachiopod colonies, which usually have only a very local horizontal distribution, but recur several times in the vertical succession. A usefnl addition to the English Great Oolite gastropod fauna is the extremely elongate *Ptygmatis bacillus* (d'Orbigny), which forms a remarkable '*Ptygmatis* rock' and serves for correlation with a type section in Gloucestershire.

A New Plant (Thallomia), showing Structure, from the Downtonian Rocks of Llandovery, Carmarthenshire. By ALBERT HEAR, M.Sc., Ph.D., F.G.S., AND JOHN FREDERICK JONES, B.Sc.

The structures of the peculiar fossil plant which are described in this communication were revealed by mechanical and chemical methods of treatment.

THALLOMIA LLANDYFRIENSIS *gen. et sp. nov.*

Diagnosis.

Thallomia gen. nov.

Flat, dorsiventral, multicellular, and multilayered thallus, exceeding 10×8 cms. in size. Dorsal surface characterised by the presence of numerous circular bodies 4 mm. in diameter, with thickened rim, which contain large numbers of disc-like cuticularized spores. Between the circular bodies lies a plexus of depressed polygonal areas. Well-preserved epidermal tissne with stomata have been recovered from the dorsal surface. The medial layer beneath these depressed areas consists of thin-walled tissue with large intercellular cavities. The medial layer beneath the ridges defining the polygonal areas consists of reinforced parenchyma with trigones. The ventral layer of imperfectly-preserved, parallel, elongated cells contains spirally-thickened elements associated with phloem-like tissue. Multicellular rhizoids occur below the central surface, but their definite connection with the plant has not been established.

GEOLOGICAL SOCIETY OF LONDON.

REPORT OF THE COUNCIL FOR 1930.

Fellowship.—During the past year 37 new Fellows were elected into the Society (11 less than in 1929). Of them, 28 paid their Admission Fees before the end of the year, while, of the Fellows elected in previous years, 12 paid their Admission Fees during 1930. The total accession of New Fellows was, therefore, 40 as compared with 50 in 1929.

The Society has lost, during the year under review, 59 Fellows (21 deceased, 17 resigned, 21 removed for non-payment of their Annual Contributions). The total number of Fellows at December 31 was 1254, made up as follows:—Compounders, 162: Contributing Fellows, 1083; and Non-Contributing Fellows, 9.

General Purposes Account.—The total income for 1930 credited to this account from all sources was £4590 9s. 10d. The expenditure debited to the account for 1930 amounted to £4404 9s. 2d. against £4506 19s. 8d. for 1929. The cash at the

Bankers' and in hand on December 31, 1930, was £313 17s. 6d., against £207 19s. 11d., on the corresponding date in 1929, and the excess of Income over Expenditure was £186 0s. 8d., as against £65 19s. 10d.

Maintenance Fund Account.—The income for 1930 was £152 17s. 7d. (of which £150 was transferred from the General Purposes Account, the balance being Deposit Interest) against £155 14s. 8d. for 1929. The expenditure debited to this account was £90 12s. 5d. compared with £166 0s. 2d. in 1929. The cash at the Bankers' and in hand was £193 17s. 10d., as compared against £131 12s. 8d. at the close of the previous year.

THE CHEMICAL SOCIETY OF JAPAN.

November 8, 1930.

Papers communicated :—

A New Method of Analysis of Cassiterite. By SETSURO TAMARU AND SUSUMU ANDO.

On the Reaction between Stannic Oxide and Barium Carbonate. By SETSURO TAMARU AND HARUO SAKURAI.

On the Existence of Enzyme which Produce the Sulphur Containing Volatile Substance from Some Mother Substances in Galic. By HIROTAKE TERASAKI AND TOKURO SODA.

November 28, 1930.

Studies on the Adsorbed Moisture in the Kanbara Clay. By HAJIME ISOBE.

A Reply to Mr. Isobe's Criticism on the Nature of Japanese Acid Clay. By NAOTO KAMEYAMA AND SHUMPEI OKA.

Terpenes and Related Compounds. IV. Methoxy-isoeugenol and -isochavibetol. II By NENOKICHI HIRAO.

Starches. I. Starches from Various Species of Plants. I. By GISABURO KASHIWAYA.

Proteins. VIII. Proteins from Soy-Beans. I. By SHIGEKIYO SUZUKI.

Alginic Acid. By TOMOWO MIWA.

Absorption of the Oxidation Products of Ammonia. I. Reaction between Nitrogen Peroxide and Water. By SETSURO TAMARU AND YASUO TANAKA.

Detection of Germanium and Gallium in some Japanese Minerals. By KENJIRO KIMURA, TOKISADA NAKAMURA AND TARO KUSHIBE.

Allanite from Yamaguchi, Nagano Prefecture. By KENJIRO KIMURA AND IETAKE OKADA.

A New Method of Synthesis of Gaylussite. By IETAKE OKADA.

On Primetin. By TEI-ICHI ASAHINA.

Studies on Sinomenine. XXII. By KAKUJI GOTO AND SHINGO MITSUI.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Monday, March 9 at 8 p.m. — (Cantor Lecture). " Sound Recording and Reproducing Machines and their Development." (Lecture I.) By Captain A. G. D. West.

Wednesday, March 11 at 8 p.m.—(Ordinary Meeting.) "Architectural Decoration." By A. J. Davies, F.R.I.B.A.

Friday, March 13, at 4.30 p.m.—(Indian Meeting.) " The Tea Industry of India in its Scientific Aspects." By Dr. Harold H. Mann.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Friday, March 6, at 9 p.m.—" Ozone in the Upper Atmosphere." By G. M. B. Dobson.

Saturday, March 7 at 3 p.m.—" Alpha-Rays." By Sir Ernest Rutherford.

Tuesday, March 10 at 5.15 p.m.—" Cytological Theory of Heredity." By C. D. Darlington.

Thursday, March 12, at 5.15 p.m.—" Respiration." By J. B. S. Haldane.

Saturday, March 14, at 3 p.m.—" Alpha-Rays." By Sir Srnest Rutherford.

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.

Friday, March 6, at 5.30 p.m.—The Watson Chair Foundation Lectures : " The Literary Relations, Past and Present, of England and the United States." First of a course of six public lectures. By George Gordon, M.A. March 6, 11, 13, 18, 20.

Monday, March 9, at 4 p.m.—" The Family of Bellini." First of a course of three public lectures. By E. K. Waterhouse. March 9, 16, and 23.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

MANCHESTER SECTION.

Friday, March 13, at 7 p.m., at Milton Hall, Deansgate.—" Recent Lines of Advance in Lake and Pigment Chemistry." By F. A. Mason, M.A., Ph.D., F.I.C.

THE INSTITUTE OF METALS.

The Twenty-Third Annual General Meeting will be held in the Hall of the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1., on Wednesday and Thursday, March 11 and 12. The following papers are expected to be submitted :—

" Investigation of the Effects of Impurities on Copper. Part VII. The Effect of Antimony. Part VIII. The Combined Effect of Antimony and Arsenic." By S. L. Archbutt and W. E. Prytherch, M.Sc.

" Some Properties of Silicon-Aluminium Bronzes." By L. J. Brice, M.Sc.

" The Corrosion of Early Chinese Bronzes." By Captain W. F. Collins, A.R.S.M.

" The Constitution of the Cadmium-Rich Alloys of the System Cadmium-Silver." By J. P. Durrant, M.A., Ph.D.

" An Investigation of the Microstructure of Fourteen Silver Greek Coins (500-300 B.C.) and Some Forgeries." By C. F. Elam, M.A., D.Sc.

" The Rolling of Alloys of Copper and Phosphorus Containing up to 5 per cent. of Phosphorus." By Owen W. Ellins, M.Sc.

" The Mode of Deformation of a Single Crystal of Silver." By H. J. Gough, M.B.E., D.Sc., and H. L. Cox, B.A.

" Dimensional Stability of Heat-treated Aluminium Alloys. By J. D. Grogan, B.A., and D. Clayton, B.Sc.

The Flow of Aluminium at Elevated Temperatures." By Professor Hanson, D.Sc.

" A Note on the Silver-Rich Aluminium-Silver Alloys above 600° C." By T. P. Hoar, B.A., and R. K. Rowntree, B.A.

" Some Properties of Metallic Cadmium." By C. H. M. Jenkins, D.Sc.

" The Effect of Artificial Ageing upon the Resistance of Super-Duralumin to Corrosion by Sea Water." By K. L. Meissner, Dr.-Ing.

" The Influence of Pressure and Temperature on the Extrusion of Metals." By C. E. Pearson, M.Met., and J. A. Smythe, Ph.D., D.Sc.

" The Solid Solutions of the Copper-Silver System." By D. Stockdale, M.A., Ph.D.

Annual Dinner and Dance.

On March 11 the Annual Dinner of the Institute will be held at the Trocadero Restaurant (Empire Rooms) Piccadilly Circus, W.1., at 7 for 7.15. The Dinner will be followed by a Dance, ending at 1 a.m. Tickets, 15s. each.

London Local Section.

Thursday, March 12 at 7.30 p.m., in the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W.1.—" Gases in Metals." By C. J. Smithells, M.S., D.Sc.

North-east Coast Section.

Tuesday, March 10, at 7.30 p.m., in the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne.—" The Extraction of Copper." By R. D. Burn, M.Sc.

Annual General Meeting.

The Committee hopes to arrange two Works Visits in addition to the above meetings.

Swansea Local Section.

Tuesday, March 10 at 6.15 p.m., in the Y.M.C.A.—" Some Researches in the Wireless Drawing Process." By Professor F. C. Thompson, D.Met., M.Sc.

The Fifth General Meeting of the Dechema, Deutsche Gesellschaft fur chemisches Apparatewesen E. V. (German Society of Chemical Apparatus) will take place with that of the Verein Deutscher Chemiker (Society of German Chemists), in Vienna, on the 28 and 29 of May, 1931.

The subject chosen for the symposium is " The Separation of Solid and Liquid Substances." Offers of contributions should be sent in not later than March 15, 1931, to the head offices of the Dechema, Seelze h., Hannover.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

4,457.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of stable ortho-amino-hydroxy-aryl-arsenic acids. February 12.

4,282.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of sulphonic acids. February 11.
—Manufacture of bismuth compounds of benzenearsinic acid-stibinic-acids. February 18.

Specifications Published.

316,324.— Imperial Chemical Industries, Ltd.,—Esters of dibasic acids, particularly esters of polyhydroxy compounds containing at least two free hydroxyl groups.

316,684.— Imperial Chemical Industries, Ltd.—Concentration of nitric acid.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

515,758.—A circular label device bearing the monogram S.W.T. and the words Genuine Tchimrent Santonin. Santonin for use in manufacture. — Kazakskiv Gosoudarstvennutv Himicheskiv Trest, Santonin Works, Tchimkent, Turkestan, Kazakstan, Russia. February 18. (Associated).

MOWITAL.

519,633.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research and anti-corrosives. — I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany. February 18.

AGROSAN.

519,613.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes.—British Dvestuffs Corporation, Ltd., Hexagon House, Blackley, Manchester. February 18th.

518,236.—A label device bearing the monogram S.T., and the numerals 37. Chemical substances used for veterinary and sanitary purposes. — *Sharp & Dohme*, Inc., 640, North Broad Street, Philadelphia, Pennsylvania, United States of America. February 18. (Associated.)

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NICKEL-COPPER ALLOYS.

HIGH-TEMPERATURE MECHANICAL PROPERTIES OF NICKEL-COPPER AND NICKEL-COBALT-TITANIUM ALLOYS.

Recent investigations carried out under the auspices of the American Society for Testing Materials and the American Society of Mechanical Engineers Joint Research Committee on Effect of Temperature on the Properties of Metals have been concerned with the determination of the high-temperature properties of copper-zinc, copper-zinc-tin, nickel-copper and nickel-cobalt-titanium alloys. The materials selected for study included various types of brass and bronze, Monel Metal, Ambrac (nickel 29.4, copper 64, zinc 5.6 per cent.) and Konel nickel 73, cobalt 17, titanium 2, iron 6.5 per cent.). The tests comprised short-time tensile tests at normal and at raised temperatures, determination of the lowest temperatures of recrystallisation, metallographic examination and long-time creep tests at elevated temperatures.

The results are presented in detail for the individual materials and are discussed in relation to chemical composition and the physical condition of the alloys. Attention is directed by the authors to the outstanding properties of the high nickel alloys; in short-time tensile tests it is these alloys which possess the maximum strength over the entire temperature range studied, while the creep test results again show them to possess maximum load-carrying capacity at all temperatures. Konel is stated to possess at 1000°F. (540°C.) the highest creep-strength value of any material known to the authors.

On the basis of the results obtained, the conclusion is drawn that the following may be considered safe working temperature ranges for the respective materials under conditions of appreciable stress :— Konel, at least 1000°F. (540°C.); Monel 800°F. 430° C.); copper-zinc alloys containing 70 per cent. copper, 400°F. (200°C.); copper-zinc alloys containing 60 per cent. of copper, 300°F. (150°C.). The relationship between lowest temperature of recrystallisation and creep strength is discussed.

C. L. Clarke and A. E. White.—" Properties of Non-Ferrous Alloys at Elevated Temperatures."

Metal Industry (London), December 26, 1930, and January 2, 1931, pp. 601 and 15.

THE COLLINSICS OF MINERALS.

XVII.

By HAWKSWORTH COLLINS, B.A. (Camb.).

The following twelve collinsics each contain the element zirconium, the only new introduction. Dana gives thirteen different crystalline forms for the mineral zircon. Only *nine are given in* Table XXXVII. His data of specific gravity are numerous, but those of refractive index are meagre. Winchell gives more values of R.I. But there is no attempt in either case to connect *the S.G. and R.I. with crystalline form.*

Winchell gives a form with S.G. 4.33 and R.I. 1.882, which he fortunately says are only approximate values. There is no form possible with these values even when allowing 1 per cent. error for each value. He seems to be of the opinion that impurities alter the crystalline form; but, if they do, the formula of an altered form is no longer *simply* $ZrSiO_4$. It is a distinct mineral with another formula.

The varying colours of zircon are due to impurities which are eliminated by the collinsics as shown in the last paper. The different crystalline forms are due to the discovered variations in the relative volumes of silicon and oxygen. The most common form is β, as the majority of values for S.G. hover round 4.612.

In order that the full reasons for the thirteen different forms may be discovered, it is necessary to know the S.G. and R.I. of each distinct crystal.

TABLE XXXVII.

THE COLLINSICS OF MINERALS CONTAINING ZIRCONIUM.

(198) Baddeleyite ZrO_2
Theor. S.G. **5.92** — Obs. S.G. 6.025 Fletcher 5.85 Nilson
$$24.2827 = 1.1782(\overset{Zr}{15.59}+\overset{O_2}{2.51_2})$$
Theor. R.I. **2.1782** — Obs. R.I. N_m 2.19W N_p 2.18 W
$$24.282 = 21.59+1.346_2$$

(199) Zircon α $ZrSiO_4$
Theor. S.G. **4.703** — Obs. S.G. 4.709 21° Cross
$$38.503 = 0.9962(\overset{Zr}{15.59}+\overset{Si}{13.02}+\overset{O_4}{2.51_4})$$
Theor. R.I. **1.9962** — Obs. R.I. N_e 1.9931 D
$$38.504 = 21.59+11.53+1.346_4$$

(200) Zircon β $ZrSiO_4$
Theor. S.G. **4.612** — Obs. S.G. 4.612 Harrington
$$36.753 = 0.9314(\overset{Zr}{15.59}+\overset{Si}{13.83}+\overset{O_4}{2.51_4})$$
Theor. R.I. **1.9314** — Obs. R.I. N_e 1.9313 D N_m 1.9277 W
$$36.754 = 21.59+9.78+1.346_4$$

(201) Zircon γ
Theor. S.G. **4.484** — Obs. S.G. 4.482 Harrington 4.489 D
$$38.905 = 0.9585(\overset{Zr}{15.59}+\overset{Si}{13.02}+\overset{O}{4.45}+\overset{O_3}{2.51_3})$$
Theor. R.I. **1.9585** — Obs. R.I. N_o 1.960 W
$$38.905 = 21.59+11.53+1.747+1.346_3$$

(202) Zircon δ
Theor. S.G. **4.28** — Obs. S.G. 4.222 Svanberg 4.35 W
$$39.306 = 0.9242(\overset{Zr}{15.59}+\overset{Si}{13.02}+\overset{O_2}{4.45_2}+\overset{O_2}{2.51_2})$$
Theor. R.I. **1.9242** — Obs. R.I. N_o 1.9239 D
$$39.306 = 21.59+11.53+1.747_2+1.346_2$$

(203) Zircon ε

Theor. S.G. **4.21** Obs. S.G. 4.21 W

Zr Si O_4

$$\mathbf{36.598 = 0.8464(15.59 + 17.61 + 2.51_4)}$$

Theor. R.I. **1.8464** Obs. S.G. N_o 1.85 W

$$\mathbf{36.599 = 21.59 + 9.625 + 1.346_4}$$

(204) Zircon ζ

Theor. S.G. **4.20** Obs. S.G. 4.2 Berlin

Zr Si O_2 O_2

$$\mathbf{37.557 = 0.8668(15.59 + 13.83 + 4.45_2 + 2.51_2)}$$

Theor. R.I. **1.8668** Obs. R.I. N_o 1.85 N_e 1.86 W

$$\mathbf{37.556 = 21.59 + 9.78 + 1.747_2 + 1.346_2}$$

(205) Zircon η

Theor. S.G. **4.17** Obs. S.G. 4.183 Damour

Zr Si O O_3

$$\mathbf{38.814 = 0.8888(15.59 + 13.02 + 7.53 + 2.51_3)}$$

Theor. R.I. **1.8888** Obs. R.I. 1.882 W

$$\mathbf{38.812 = 21.59 + 11.53 + 1.654 + 1.346_3}$$

(206) Zircon θ

Theor. S.G. **4.092** Obs. S.G. 4.072–4.222 Svanberg
4.06 W

Zr Si O O_3

$$\mathbf{37.065 = 0.8333(15.59 + 13.83 + 7.53 + 2.51_3)}$$

Theor. R.I. **1.8333** Obs. R.I. 1.826 W

$$\mathbf{37.062 = 21.59 + 9.78 + 1.654 + 1.346_3}$$

(207) Zircon ι

Theor. S.G. **4.028** Obs. S.G. 4.047 Damour 4.02 D

Zr Si O O_3

$$\mathbf{37.002 = 0.819(15.59 + 17.61 + 4.45 + 2.51_3)}$$

Theor. R.I. **1.819** Obs. R.I. 1.826 W

$$\mathbf{37.000 = 21.59 + 9.625 + 1.747 + 1.346_3}$$

(208) Catapleiite $H_4Na_2ZrSi_3O_{11}$

Theor. S.G. **2.745** Obs. S.G. 2.75 W

H_4 Na_2 Zr Si_2 Si O_3 O_8

$$\mathbf{86.595 = 0.5943(5.76_4 + 11.865_2 + 15.59 + 13.83_2 + 13.02 + 7.53_3 + 2.51_8)}$$

Theor. R.I. **1.5943** Obs. R.I. N_m 1.592 W

$$\mathbf{86.592 = 2.613_4 + 3.865_2 + 21.59 + 9.78_2 + 11.53 + 1.654_3 + 1.346_8}$$

(209) Elpidite $H_6Na_2ZrSi_6O_{18}$

Theor. S.G. **2.572** Obs. S.G. 2.58 W

H_6 Na_2 Zr Si_6 O_{18}

$$\mathbf{131.978 = 0.5676(5.76_6 + 11.865_2 + 15.59 + 18.91_6 + 2.51_{18})}$$

Theor. R.I. **1.5676** Obs. R.I. N_m 1.565 N_g 1.574 W

$$\mathbf{131.992 = 2.613_6 + 3.865_2 + 21.59 + 10.461_6 + 1.346_{18}}$$

TABLE XXXVIII.

THE VOLOPTICS OF THE REQUIRED ELEMENTS

(as found from the first 209 Collinsics).

	R.V.	O.R.	No. of times this voloptic has occurred in the first 209 collinsics
O	7.53	*1.654	266
O	4.45	1.747	249
O	2.51	1.346	1533
Si	18.91	10.461	58
Si	17.61	9.625	61
Si	13.83	9.78	63
Si	13.02	11.53	76
Zr	15.59	21.59	12
H	5.76	2.613	861
Na	11.865	3.865	64

The above table is intended to be read as follows :— When an atom of oxygen has the relative volume 7.53, its optical refractivity is 1.651, and this voloptic (*i.e.*, this pair of values) has now occurred 266 times in the collinsics; and so on.

When an element has more than one relative volume as in the cases of silicon and oxygen, this fact is not an indication of any weakening in the argument but a very great strengthening, because each volume has a corresponding O.R.

Method of Discovery of the Collinsic of Baddeleyite.

15.59 and 18.59 were shown to be relative volumes of Zr by the law of heat of formation (*Chem. News*, 1926, cxxxii, 246) long before the collinsics were discovered. It was also known that 21.59 was another volume. By calculations from data of all minerals containing Zr it was found that 21.59 was the O.R. of the R.V. 15.59.

In the case of Baddeleyite, divide the molecular weight 122 by 6, the approximate observed S.G., obtaining the molecular volume 20.33. Multiply this by 1.19 (μ-1) obtaining 24.19. It is therefore settled by experimental data that the mol. vol. of baddeleyite must be about 20.33, and the O.R. about 24.19. As the lowest R.V. of oxygen is 2.51 and the lowest of Zr is 15.59, and since $15.59+2\times 2.51=20.61$, it is evident that if the corresponding sum of the *O.R.'s of these two elements* does not amount to about 24.19, the collinsic cannot be found.

$$21.59+2\times 1.346=24.282$$

This result is so near to the rough approximation that it is evident the truth has been obtained.

Starting again with the certainty that the molecular volume of baddeleyite is 20.61 and dinviding 122 by it, 5.92 is obtained as the true S.G. of the pure substance, which lies between the two observed S.G.'s of the impure substance. Multiplying 20.61 by 1.1782, 24.2827 is obtained, which is correct to five figures with the required O.R. 2.1782 is easily within 1 per cent. of 2.19, the experimental mean R.I. obtained by Winchell.

The Structure of an Atom of Zirconium.

The structure obtained for Zr by reason ing upon atomic weight, valency and mineralogical facts, and published in the Chemical News, 1920, cxxi, 183, was $Zr = Cu+Al=Ca+Na+Al=Ca+Na+Na+H+H_3$

If the two sodium portions combine, as frequently happens, by their valences and also by some forces which are not chemically evident, the helium portion ($H+H_3$) is left free with its two electro-positive forces, and the two valences from the Ca-portion are electro-negative in accordance with the law (*Chem. News*, 1924, cxxix, 47), so that Zr is a tetradic (dibasic and diacidic) nonmetallic element. This matter can only be fully appreciated by reference to all the papers under the same authorship, commencing with the one in the *Chemical News* 1907, xcvi, 175, which was published by Sir William Crookes on the recommendation of Sir William Ramsay.

Later the relative volumes of Zr were found to be :—

Table XXXIX.

Zr		Ca	+	Na	+	Al
15.59	=	0	+	6.54	+	9.05
18.59	=	0	+	6.54	+	12.05
or	=	0	+	9.54	+	9.05
21.59	=	0	+	9.54	+	12.05

6.54 and 9.54 have frequently been shown to be volumes of Na when forming part of an element, and 9.05 and 12.05 have been demonstrated as the combining relative volumes of Al in the collinsics 109 and 32 times respectively.

In each case the volume of the Ca-portion is zero; *i.e.*, by the Law of relative volume (*Chem. News*, 1926, cxxxii, 325) this portion of the element is absorbed by the remainder. But although it is inside, its two valences are active externally.

There is nothing very extraordinary about this, because the powder and shell inside a cannon constitute a potential internal force ready for external action when required.

The Structure of an Atom of Sodium.

The relative volume of an atom of Na has been shown 64 times in the collinsics to be 11.865 and in every case its O.R. is 3.865. Its structure was given in the *Chem. News*, 1925, cxxxiii, 401, as the combination of an atom of boron with one of carbon from considerations of atomic weight, valency, heat of formation and relative volume.

Again, the rel. vol. of an atom of boron has been shown 27 times in the collinsics to be 3.865 and in each case its O.R. is also 3.865.

And the R.V. of an atom of carbon has been shown to be 8 a great number of times from the year 1924 onwards; so that the structure of sodium is evident unmistakeably from the following table :—

TABLE XL.

	Na	=	C	+	B
Atomic weights ...	23	=	12	+	11
Valences	1	=	4	-	3
Relative volume (combining) ...	11.865	=	8	+	3.865
Optical refractivity	3.865	=	0	+	3.865
O.R. of boron ...					3.865
R.V. of boron ...					3.865

It is evident from the above table that the R.V. of the carbon-portion of an atom of sodium is always 8, and that it is so placed in the crystal that a ray of sodium light in passing through it is not deviated in the slightest, the whole deviation of the ray being due to the boron-portion of the atom.

BRITISH INDUSTRIES FAIR.

This year's British Industry Fair, held simultaneously in London and Birmingham, has proved as successful as the most optimistic could have wished. The number of visitors both British and overseas has so far exceeded the corresponding numbers of previous years and there is every reason to suppose that, in general, the exhibitors are very well satisfied by the business done..

The chemical exhibits, under the excellent guidance of the Association of British Chemical Manufacturers is a credit to the chemical industry. Over 3,000 chemical substances are to be seen in this section whilst the plant of British manufacture is shown to be of a high standard.

The products covered include all heavy and fine chemicals, pharmaceutical and photographic chemicals, perfumes, coal tar derivatives, dyestuffs and their intermediates. The directory issued by the Association of British Chemical Manufacturers is in six languages and should be in the hands of those contemplating the purchase of chemicals. Undoubtedly the Chemical Section of the British Industries Fair has made an even more imposing portion of the exhibits than last year, which was considered to have surpassed all previous efforts.

THE FERMENTATION INDUSTRIES FOR 1930.

By H. LLOYD HIND, B.Sc., F.I.C., AND F. E. DAY, B.Sc., F.I.C.

(Abstracted from the Report prepared for the Society of Chemical Industry and the Institute of Brewing.)

(Continued from page 149.)

Essential Oils of Hops.—The aroma of hops is to a large extent due to essential oils contained in the lupulin glands. Our knowledge of these is mainly derived from the work of A. C. Chapman, who in a recent paper has reviewed and summarised his investigations. Altogether he has investigated eight definite compounds, several of which have been found in other essential oils, whilst others are new. They differ markedly in aroma, and it is on the varying proportions in which they exist in the oil that the aromas of different hops depend. Chapman's earlier investigations referred to the lower-boiling oils in which he found myrcene, humulene, linalool, linalyl *iso*nonoate, and geraniol. In his later work he dealt with higher-boiling fractions from which he isolated luparone, luparenol, and luparol. Chapman considered that the sesquiterpene humulene was different from any of those already known, but this Deussen contested, and he stated that it was identical with "inactive caryophyllene." Further investigations have, however, convinced Chapman that his original view was correct.

INDUSTRIAL FERMENTATIONS.

Discussing the chemical approach to fermentation, E. I. Fulmer drew atttention to the change in usage of the word "fermentation" from its original application to microbiological actions accompanied by copious evolution of gas, to any enzymic action, whether it involved gas production or not, or even brought about by enzymes, apart from living organisms. Fermentations are catalyses, and the typical fermentations, involving microbiological processes, differ from the catalytic processes of ordinary industrial chemistry in that the catalyst is manufactured during the course of the reaction. Consequently the course of any reaction of this kind may be altered profoundly by changes in the external physical conditions or in the composition of the nutrients, though the organism and the substrate may be the same. An excellent

example is that of yeast, which normally produces much alcohol and very little glycerol, but in presence of excess of alkali or of sulphite produces much glycerol and little alcohol. Mention is made of "synergism," the capacity of two organisms together in one medium to effect a change, of which neither is separately capable.

The industrial value of fermentation processes depends on their mild action as compared with the great majority of ordinary chemical actions; indeed, as the author remarked, if micro-organisms were able to secure the maximum energy yield, and oxidise the substrates to water and carbon dioxide, there would be no such thing as the fermentation industry. In a chart he gives a list of forty-eight substances produced by the fermentative decomposition of sugars, and against them the transformations which these same substances may undergo among themselves by further microbiological action. These changes are not necessarily decompositions. The occurrence of syntheses is exemplified by the production of $\beta\gamma$-butylene glycol and acetylmethylcarbinol from acetaldehyde. In this connexion the recent observation by F. Challenger, L. Klein, and T. K. Walker, that a six-carbon acid, kojic acid, is produced from pentoses by *Aspergillus oryzæ*, may be noted, and it seems possible that it will ultimately be found that fermentation methods may be of real value in syntheses as well as in decompositions. At present the study of the problem of fermentation is in its infancy, and the scope for research both in the purely bio-chemical and in the applied fields appears to be endless.

Lactic Acid. In addition to its extensive use in the leather industry a large amount of lactic acid is employed in the manufacture of ethyl lactate for use at a nitrocellulose solvent. More surprising is its increasing use in the manufacture of foods and beverages, and it is considered that further extensions of its use are to be anticipated in this direction. Of suggestions for the improvement of lactic acid manufacture which have appeared in recent years, mention may be made of the organism *Termobacterium mobile*, isolated by P. Linder from the *Agave americana*, and to *Lactobacillus acidophilus B.*, the use of which has been patented by the Société Anonyme des Distilleries Deux-Sèvres. Both these organisms are characterised by a relatively high production of acid from sucrose or its inversion products.

Vinegar and Acetic Acid.—Most of the literature regarding the acetic fermentation which has appeared during the past year or so has been concerned with methods of analysis. G. Donà proposes to determine the dry extract of vinegar by taking the specific gravity of the boiled sample and after correcting this by the specific gravity of dilute acetic acid of the same titre, dividing the result by a factor. W. Schut determines formic acid by heating 1 c.c. at 150° with concentrated sulphuric acid and measuring the carbon monoxide produced. A more important paper by U. Pratlongo and M. P. Allan deals with the distinction between different grades of wine vinegar and synthetic and distilled vinegars. Fermentation vinegars have a very much higher iodine value than artificial vinegars, and in addition show a strong luminescence when exposed to ultra-violet light. The acetic acid, alcohol, extract, ash, and alkalinity of the ash of marc vinegars are lower than those of genuine wine vinegars. They may be distinguished from diluted wine vinegars by the greater values of the ratios ash : extract and fixed acidity : acetic acid +alcohol. Owing to its higher dissociation constant, small additions of strong mineral acid may be detected by colorimetric determination of the p_H, which in wine vinegars is lowered by 0.2 unit by each 0.1 per cent. of sulphuric acid. A. Jancke and H. Lacroix also consider the iodine value and luminescence of fermentation vinegars to be the best means of distinguishing them from artificial vinegars, though the intensity of the luminescence does not run parallel with the iodine value. These two properties are both shown by alcoholic solutions of mineral salts which have been fermented by *B. ascendens*. It, therefore, appears that they are due to products of bacterial metabolism.

The most important recent contribution to our knowledge of the acetic fermentation is due to E. Wieland and A. Bertho, who have investigated the mechanism of the reaction, a study carried still further by the latter author. Since the enzyme cannot be separated from the living bacteria, and is destroyed by any treatment such as is used to kill yeast for the investigation of zymase, it was necessary to carry out the work with suspensions of living bacteria. The reaction is considered to involve the presence of a substance (donator), normally ethyl alcohol, of which two hydrogen atoms are "activated," and of another (acceptor),

normally oxygen, capable of combining with this hydrogen, the reaction taking place between molecules absorbed on the surface or combined with the enzyme. The course of the reaction between ethyl alcohol and oxygen is proportional to the time and is strongly inhibited by hydrogen cyanide. The reaction between acetaldehyde and oxygen is similar but slower, is less affected by hydrogen cyanide owing to the formation of cyanohydrin with the excess of the aldehyde, and is probably brought about by the same enzyme since the oxidation of mixtures of alcohol and aldehyde takes place at a rate intermediate between those of the two measured separately. Since, in such mixtures, the oxidation of the aldehyde occurs at a rather greater rate proportionally to that of the alcohol than would be expected, it seems that it is preferentially adsorbed by the enzyme. A similar and still more marked effect is found when benzoqninone replaces oxygen as acceptor; not only is the reaction rate greatly increased, but the reaction with oxygen, if this is also present, is retarded, and the inhibiting effect of hydrogen cyanide is much less marked.

These phenomena are explained, with an exception in the case of oxygen and quinone, referred to below, as due to preferential adsorption. Methylene-blue and similar dyes can act as acceptors, but owing to their adsorption by the cell walls, and their slow penetration into the interior, where 90 per cent. of the reaction takes place, they are unsuitable for the investigation of the kinetics of the reaction. Of the substances examined, methyl, ethyl, propyl, *iso*butyl, and *iso*amyl alcohols, and their corresponding aldehydes, phenylethyl alcohol, *iso*propyl alcohol, and dextrose act as donators, but not benzyl or o-hydroxybenzyl alcohol, salicylaldehyde, acetone, acetic or succinic acid. Dithioglycollic acid, cystine, ethyl peroxide, and potassium persulphate are incapable of acting as acceptors. Bertha studied the kinetics of the reaction and give *ps* curves relating the velocity of the concentrations of aldehyde, *iso*propyl alcohol and quinone. The dissociation constants and relative rates of decomposition for several donator-enzyme-acceptor systems have been determined. The velocity of the reaction between *iso*propyl alcohol and oxygen, unlike those in which quinone is the acceptor, does not fall off, but increases uniformly as the concentration increases. *This indicates the* extremely high affinity of the enzyme for the natural acceptor, and the inhibition of the action of oxygen by quinone is attributed to its exclusion from the active surface by the large quinone molecules.

PRAGUE SAMPLES FAIR.

The next trade fair at Prague—the twenty-second of the series to date—will be held on the 22-29 of March, 1931. In consequence of reports—largely inaccurate—as to the financial situation of the undertaking, suggestions have appeared in the Press to the effect that the fair might not take place or would be held on a reduced scale. We are informed that there is no foundation whatsoever for these suggestions. The financial matters referred to are a question of the conversion of mortgages and of a definite settlement of the matter of the co-operation of the State in the undertaking. The Fair in March will be held as usual on the Exhibition Grounds and in the new Fair Building. There will be the ordinary seventeen groups of exhibits, namely: Building trade; metallurgical industries; electrical engineering, mechanics and optics; timber and woodworking trades; textiles; clothing and outfitting; fancy goods; leather trade, boots and shoes; glass, porcelain and ceramics; industrial art; chemicals and sanitation; provisions and agricultural products; musical instruments; toys; paper, school and office requisites; jewellery, clocks and watches; miscellaneous group. In addition to these ordinary groups there will be a number of special " fairs " including motor cycles and motor accessories; hotel and innkeepers exhibition; wireless, rubber, furniture, piano, and boiler groups.

Special visa facilities are available for foreign visitors to the Fair on application to the Czechoslovak Consulate in their country (in so far as visas are still required), and reductions of fare are granted on the Czechoslovak State Railways (33 per cent.), as well as on those of all the neighbouring countries — Germany, Austria, Hungary, Poland, Rumania, Italy, Switzerland, Yugoslavia, Bulgaria and Greece (20 per cent. to 50 per cent.), by the Danubian and Adriatic navigation companies, and by the International Air Company.

GENERAL NOTES

CANADIAN WHITING SUBSTITUTE.

Whiting and whiting substitute are used by a wide variety of Canadian industries, entering largely as they do into the manufacture of putty, oilcloth, linoleum, cold water paints, rubber goods, blackboard crayons, and a number of scouring, cleansing and polishing mediums such as hand soaps and metal polishes. They are also used for ceramic glazes and in the making of white-shoe paste, fireworks, certain inks and dyes, some kinds of picture moulding, and a number of other articles. One Canadian industry uses 250 tons of whiting and whiting substitute a month when working to capacity.

Whiting is merely finely pulverised chalk. Whiting substitute is finely pulverised limestone, marble, calcite, or freshwater marl; it is also obtained as a by-product in the manufacture of caustic soda .

The manufacture of whiting substitute first came into prominence during the World War when supplies of chalk whiting were difficult to obtain. Since then it has become an established commodity and is steadily finding an increased market. As the name implies, the substitute is used in place of whiting. The two are very similar in most respects and may be indentical in chemical composition. The chief points of difference seem to be in the shape of the individual grain and in the absorptive chalk whiting is round and has high absorptive capacity, whereas that of limestone whiting is angular evenly when extremely capacity for oils and water. The gram of pulverised and has low absorptive capacity. For many industrial uses, however, these particular properties are not of importance and the substitute can be used instead of true whiting.

Although it is not generally known, two Canadian firms, one in Nova Scotia, the other in Manitoba, have been manufacturing whiting substitute from domestic limestones for a number of years. Their production, however, was consumed locally and did not enter the principal markets which are in Montreal and Toronto, and which until lately were being supplied entirely by imported material. Recently, however, a plant capable of producing 12,000 tons of whiting substitute annually has been established in Montreal. This plant also is using domestic raw materials.

The main requirements of a limestone or marble to yield whiting substitute suitable for the general trade, are that it be white or light grey in colour; be free from mica; consist principally of calcium carbonate; and preferably be fine-grained and free from grit. When pulverized it should yield a snow-white powder. Chemical purity is not essential but is desirable. White crystalline dolomites are suitable for some uses.

It should be noted that each limestone deposit will yield a whiting substitute with individual characteristics, and it should not be assumed that because material from one deposit has proved satisfactory for any particular purpose that all whiting substitute will be likewise.

A survey of the limestone resources of Canada by the Department of Mines has revealed the presence of suitable limestones for whiting substitute in Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba and British Columbia. The preparation of trial lots has demonstrated that the Canadian deposits will yield products which compare very favourably with the best of the whiting substitute now being imported. In addition there are some deposits of white marl in the prairie provinces and in eastern Canada which have distinct possibilities of also yielding a high-grade whiting substitute. Thus there would appear to be no reason why the Canadian market for this material should not be entirely supplied from domestic resources.

DENMARK.

Methods of Trading and Terms of Payment, etc.

A confidential memorandum containing information as to the methods of trading and terms of payment prevailing in relation to business with Denmark, together with notes on the general features of the market, prepared by the Commercial Secretary to His Majesty's Legation at Copenhagen, has been received and issued by the Department to firms whose names are on its Special Register. British firms who desire to obtain a copy of the memorandum and particulars of the Special Register service should apply to the Department. Reference No. C.X. 3463 should be quoted.

13th EXPOSITION OF AMERICAN CHEMICAL INDUSTRIES.

Four hundred and fifty or more exhibits will fill three spacious floors of Grand Central Palace, New York, when the 13th Exposition of Chemical Industries opens the week of May 4 to 9. These displays will illustrate scores of phases and ramifications of the vast industries that are dependent in their operation upon a chemical change in the nature of the material, or are under chemical control. Among the numerous layouts will be raw materials, chemicals, machinery, boiler room equipment, including refractories, gauges, automatic control and other precision instruments, and laboratory equipment, besides a list of equipment and supplies hardly to be classed under any of the foregoing heads. The following is a more elaborate partial classification :

Chemicals Oils, greases, fats, fatty acids, lacquers ,enamels. Industrial chemicals, carbons, pigments, alkalies, cement, high temperature plastics, rust proofing, refractories, laboratory chemicals, lime—chemical and hydrated—fire proofing compounds, various gases, resins, dyes, solvents, metal coatings, decolourizing and purifying materials, building materials.

Metals—Castings, iron, bronze, perforated metals, alloys, ferrous and non-ferrous steels, precious and semi-precious metals.

Machinery.

Instruments of Precision and Laboratory Equipment.

Containers.

Materials Handling Equipment.

Rubber and Hard Rubber Products.

Southern and Canadian Sections.

The exhibits of the various types of chemicals and machinery will allow the visiting engineer and executive to compare at first hand the various types of materials, equipment and chemical practices with many new features exhibited for the first time. Of particular interest to chemistry teachers from academies and high schools will be the conferences on Tuesday, Thursday and Friday afternoons, on the problems of teaching chemistry. It is expected that college professors and other will be present at these discussions to express opinions and ideas on teaching chemistry.

When it is remembered that no other similar opportunity exists for the comparison of competitive devices in these and many other lines related to the chemical industries, it is not surprising that the biennial Exposition of Chemical Industries regularly draws tens of thousands of engineers, chemists and plant executives from nearly every state in this country and all industrial nations of the world.

ELECTRIC LAMP DANGER.

Ordinary Little Task That Cost Six Lives Last Year.

In the ordinary, everyday little task of putting an electric lamp into its socket, six factory workers were electrocuted last year, and many others were seriously injured.

This is due to the replacement of the old " bayonet " type of lamp, with which almost every householder is familiar, by a screw-in type. With this type, there is only one terminal in the top of the lamp, the curreut passing in circuit to the filament and then via the screw of the lamp to the screw of the holder.

" If the screw-in type of holder is incorrectly wired, the socket becomes charged with electricity and a workman gets a severe shock upon touching it," an official of the Home Office Industrial Museum at Westminster, stated in an interview. " There is no danger from the cap if the wiring is done properly, but the number of accidents reported to us shows that wiring mistakes are common. We are exhibiting in this Museum five different methods of wiring, and electricians, employers, works council members and others can see for themselves how accidents can be avoided. Some of the actual lampholders involved in fatal accidents are shown. One exhibit shows a number of lampholders fitted with extension or " skirt " covering well beyond the metal cap of the lamp, and this type cannot be accidentally touched.

INDIA'S TRADE IN NOVEMBER, 1930.

Imports from the United Kingdom fell from 39 per cent. in November, 1929, to 34 per cent. and exports to the United Kingdom from 28 to 27 per cent. The shares of Germany, Japan and the United States during the month under review were respectively 7, 8 and 9 per cent. under imports and 6, 10 and 11 per cent. under exports.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

February 26.

The following papers were read :—

J. C. Eccles and Sir Charles Sherrington, F.R.S.—*Studies on the Flexor Reflex.* I. Latent Period.

A method for measuring the latent period of flexor reflex is described. The values obtained for the central reflex-time range from 2.75 σ to 4.35 σ, and are in general agreement with the values calculated by Jolly and by Forbes and Gregg.

The central reflex-time is found to be shortened when the stimulus applied to the afferent nerve is strengthened.

The temporal dispersion of many reflex discharges is shown to be due, not to the discharge of more than one impulse from motoneurones, but to variations in the latent periods of the single responses of different motoneurones.

The latent period of the response to a centripetal volley is greatly shortened if another volley precedes it by certain intervals. This shortening of latent period occurs at the expense of central reflex-time which in some cases is reduced to less than 0.5 σ. It is concluded that all the time is saved in the reduction of the normal " synaptic " delay facilitation. If that is so, the actual conduction-time through the spinal cord must be less than 0.5 σ. On the assumption that normal " synaptic " delay is due to time taken for a succession of excitatory impulses (owing to their temporal dispersion) to build up a c.e.s. of threshold intensity, all the observations are satisfactorily explained.

The experiments support the conclusion drawn from other experimental observations that, in the flexor reflex, centripetal impulses are not transmitted straight through the spinal cord, but at certain points (" synapses ") they are transformed into an enduring excitatory condition, c.e.s., which may in turn set up fresh nerve impulses—the reflex discharge.

J. C. Eccles and Sir Charles Sherrington, F.R.S.—*Studies on the Flexor Reflex.* II. The Reflex Response Evoked by Two Centripetal Volleys.

When the interval between two centripetal volleys is short, the reflex contraction evoked by the second volley is due largely to the discharge of motoneurones which fail to respond to either volley alone. The response of these motoneurones is due to summation of the subliminal excitatory effects of each volley.

In addition to this facilitation at short intervals, a centripetal volley gives rise to a period of unresponsiveness of motoneurones. Three types of unresponsiveness have been met with.

1. Recovery *complete* in less than 16 σ. Here the unresponsiveness is almost certainly a true refractory period following the reflex discharge set up by the first volley.
2. Recovery complete in less than 50 σ. In the more prolonged cases the unresponsiveness is due to an inhibition set up by some of the impulses of the first volley. When recovery is complete in less than 30 σ, it is not known whether the unresponsiveness is due to inhibition or refractory period.
3. Recovery not complete for more than 80 σ. This prolonged unresponsiveness is due to the inhibition produced by some of the impulses in the first volley.

From theoretical considerations it is deduced that the duration of the relatively refractory period following an antidromic volley (10.5 σ) is likely to be identical with the duration of the relatively refractory period of the reflex arc.

J. C. Eccles. *Studies on the Flexor Reflex.* III. The Central Effects Produced by an Antidromic Volley. Communicated by Sir Charles Sherington, F.R.S.

When a single stimulus is applied to an intact motor nerve, a volley of impulses (called an antidromic volley) passes into the spinal cord through the ventral roots. There has never been any evidence that an antidromic volley evokes a reflex discharge from motoneurones. The antidromic volley sets up a condition of raised neurone-threshold (a refractory period) in the reflex centre which lasts for about 10.5 . The duration of the absolutely refractory period is less than 2.5 while the remaining 8 σ is a relatively refractory period.

From other experimental evidence it is concluded :

(*a*) that a single centripetal volley gives rise to c.e.s. during a considerable period,

(*b*) That the persistence of the c.e.s. set up by a single centripetal volley is due partly to the temporal dispersion of the incident excitatory im-

pulses and partly to the c.e.s. produced by any particular impulse itself enduring for some time,

(c) that in any motoneurone an antidromic impulse removes preformed c.e.s.

J. C. ECCLES and SIR CHARLES SHERRINGTON, F.R.S.—*Studies on the Flexor Reflex.* IV. After Discharge.

A period of quiescence follows an antidromic volley set up during the after-discharge of a reflex evoked either by a single centripetal volley or by a repetitive series of centripetal volleys (confirming Denny-Brown).

The duration of this period of quiescence (usually 20 σ to 50 σ) is too long to be explained by the raised neurone-threshold (central refractory period) set up by the antidromic volley. It must be due to the removal of c.e.s. by the antridromic volley.

Since some motoneurones are protected from the antidromic volley by impulses which they have just discharged, the *complete* absence of after-discharge during the period of quiescence suggests that a motoneurone is affected by a reflex discharge in the same way as by an antidromic volley.

The conclusion arrived at is, therefore, that preformed c.e.s. of a motoneurone is removed by a reflex discharge and has to be built up again by delayed excitatory impulses before another discharge can occur. Hence after-discharge depends on the continued arrival of delayed excitatory impulses.

On the basis of these conceptions the duration of the period of quiescence should be approximately the same as the interval between successive discharge of the motoneurones.

J. C. ECCLES and SIR CHARLES SHERRINGTON. *Studies on the Flexor Reflex.* V. General Conclusions.

A brief statement with discussion of various views of the nature of central excitation in reflex activity.

A. V. HILL, F.R.S. and J. L. PARKINSON—*Heat and Osmotic Change in Muscular contraction without Lactic Acid Formation.*

Frogs' muscles poisoned with iodo-acetic acid, in which no lactic acid is formed, when stimulated to exhaustion in nitrogen gave total heat 0.367 cal. per 1 g. and showed a rise of osmotic pressure equal to that caused by the addition of 0.147 of NaCl to Ringer's fluid. This change of osmotic pressure cannot be explained in full without assuming either (a) that some chemical reaction, hitherto unrecognised, occurs in such poisoned muscles when stimulated, or (b) that phosphagen (and perhaps adenyl-pyrophosphoric acid) exist not as simple molecules in the resting muscle but in some combined form.

ROYAL INSTITUTION.

At a General Meeting of the Members of the Royal Institution held on March 2, Sir Robert Robertson, Treasurer and Vice-President, in the Chair, the death of Sir Charles Parsons, Vice-President, was announced and a resolution of condolence with the relatives was passed. The thanks of the Members were returned to Dr. W. Rushton Parker for his donation of 100 guineas to the Research Fund. Rev. John M. Ballard, A. Q. Carnegie, Mrs. Grace D. Caroe, A. St. George Caulfeild, W. J. Corbett, The Hon. Violet Douglas-Pennant, E. V. Evans, Miss Helen S. Gilchrist, Paul E. Newman, Lady Stonehaven, Rev. C. D. Thomas, Mrs. J. P. Trevelyan, Dr. W. A. Troup, Mrs. Van Montagu, Colonel W. A. Vignoles were elected members.

THE PHYSICAL SOCIETY.

February 6.

The following papers were read :—

A Ballistic Recorder for Small Electric Currents. By E. B. MOSS, B.Sc.,

The standard thread recorder is so modified that it records ballistic throws in instead of the usual steady deflection. By this means the current-sensitivity may be increased at least twenty-five times.

The Instrumental Phase-Difference of Seismograph Records; an Illustration of the Properties of Damped Oscillatory Systems. By F. J. SCRASE, M.A., B.Sc., Kew Observatory.

A discussion is given of the method of interpretation of the maxima shown on the records of earthquakes during the surface-wave phase. The usual procedure is to treat the waves (which actually appear as beats) as being truly simple harmonic and to apply the formulae which are derived on this assumption. It is shown that, in general, this procedure does not necessarily lead to the correct interpretation. In the case of direct registration the true earth maximum may have occurred one half-period later than the time obtained by the

usual correction. With galvanometric registration the maximum may have occurred either one, two, or three half-periods earlier than the time indicated by the usual formula due to Galitzin. Some curves are included to illustrate these points, and an attempt is made to obtain a mathematical explanation.

The Reflecting Powers of Rough Surfaces at Solar Wave-lengths. By H. E. BECKETT, B.Sc.

A study of the reflecting properties of building materials for solar radiation has been made, a hemispherical mirror being used for integrating diffuse-reflected energy upon a thermopile receiver. The paper follows the work of Coblentz and Royds and deals at length with the errors inherent in the method and with the adjustment of the apparatus. The theory of the method is simplified by the introduction of an auxiliary specimen which, in particular, renders the observations independent of the degree of blackness of the thermopile receiver. Reflecting powers for a large number of building materials are given for four radiation bands within the solar range, and also for the composite radiation obtained by the screening of a pointolite lamp with a thin gold film. The latter radiation somewhat recembles that of the sum in range and dis tribution, and enables the reflecting power of a surface for total sunlight to be determined approximately in a single reading. The apparatus has been tested with magnesium-carbonate surfaces and yields reflecting powers in the visible spectrum in good agreement with those found photometrically.

March 6.

The following papers were read :—

Practical Investigations of the Earth Resistivity Method of Geophysical Surveying. By G. F. TAGG, B.Sc., A.M.I.E.E.

The paper deals with the methods of geophysical survey which depend on the measurement of the electrical resistivity of the earth. The theory is explained for the case of a single horizontal stratum, and practical tests are described and discussed.

A Photoelectric Spectrophotometer for Measuring the Amount of Atmospheric Ozone. By G. M. B. DODSON, D.Sc., F.R.S.

Details are given of a spectrophotometer for use in measurements of the amount of ozone in the atmosphere, photographic processes being rendered unnecessary by the use of a photoelectric cell.

Displacements of Certain Lines of the Spectra of Ionised Oxygen (O II, O III), Neon (Ne II) and Argon (A II). By W. E. PRETTY, B.Sc., A.R.C.S., D.I.C., Assistant Lecturer in Physics, Imperial College, South Kensington.

In continuation of an investigation of the displacements which characterise certain spectral lines produced in a discharge tube at moderate gas pressure (of the order of a few cm.), the spectra O II, O III, Ne II and A II have been studied. As in the case of N II, which has been examined previously, many lines in each of the spectra are displaced to the red and for the majority of the lines the amount of displacement has been determined. The term shifts so obtained have been discussed in relation to the term schemes for each of the spectra. A comparison of the term shifts in the various spectra has been made and it is found that the 4s terms of O II, O III, N II and Ne II, and the 5s terms of A II (^3P family) all show roughly the same shift. Some typical shifted lines have been examined with a microphotometer and the curves are reproduced. The suggestion made in the previous paper that the shift is probably a Stark effect receives further support.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

3, 5-Diketopyrazolidine Derivatives. I. By TOKUICHI TSUMAKI.

Becquerel's Effect of Copper Oxide in Alkaline Solution. II By YOGORO KATO AND NAGAO HAYAMI.

Some Derivatives of Safrol. I. By KINZO KAFUKU AND CHIUTA HATA.

Terpenes and Related Compounds. VII. Ethoxyisoeugenol and Ethoxyisochavibetol. II. By NENOKICHI HIRAO.

Catalytic Reaction between Stannic Oxide and Lime. By SETSURO TAMARU AND NOBORU ANDO.

Analysis of Monazite from Jun-an, Korea. By KENJIRO KIMURA AND SAKAE SHINODA.

Detection of Germanium and Gallium in Some Japanese Minerals. By KENJIRO KIMURA, TOKISADA NAKAMURA AND TARO KUSIBE.

Binary System of Primetin-Flavone. By TEI-ICHI ASAHINA.

NOTICES OF BOOKS.

Laboratoriumsbuch für den Nahrungsmittelchemiker. By PROF. A. BEYTHIN. Pp. 588. Dresden and Leipzig: Theodor Steinkopff. 1931. Price 38 marks.

Dr. Beythin has succeeded in compressing within the covers of this substantial volume the whole range of products which the public analyst is called upon to examine. These include all classes of foodstuffs, beverages, condiments, tobacco, water, air and other mixed gases, and the identification of poisons.

Whilst the analysis of some products (*e.g.*, special sausages) is of limited interest outside Germany or the continent, by far the bulk of the methods and other matter contained in this book is of interest to analytical and other chemists in this country and indeed throughout the world. In the course of a very wide experience as chief of the Analysts Laboratory in Dresden, Dr. Beythin has introduced practically all the accepted methods of examining the various products and the latest procedure in all sections is given, including not only the purely chemical methods but also the microscopic and bacteriological technique which is now a necessary part of all such analytical work.

This important treatise therefore deserves the attention of all analysts and others concerned with the examination of foodstuffs, etc.

Collection of Czechoslovak Chemical Communications.

We have received the special double number of this journal (Jan.-Feb., 1931), which is dedicated to the memory of the late Prof. F. Wald, who died in his 70th year in October of last year. Prof. Wald was for many years a metallurgical chemist but he interested himself also in theoretical and physical chemistry. He put forward unusually original views concerning the nature of chemical change, the phase rule and the structure of the elements and enjoyed the friendship of Prof. Ostwald, whose views very largely coincided with his own.

In metallurgical and analytical chemistry he devoted himself to the task of adapting the standard chemical methods to the special needs of industrial practice, especially in the examination of alloys. Altogether he published some 70 papers which are given as a bibliography in this special issue of the *Collection of Czechoslovak Chemical Communications*. This number, which is the first part of the third volume of the Journal, runs to 134 pages and contains 16 original articles, mostly in English, whilst the rest are in French.

Prof. Baborovsky has written the life of Prof. Wald, Dr. A. Kríz describes his theoretical contributions to stoichiometry, and Dr. O. Quadrat gives an account of Wald's work in analytical chemistry. In addition to this, there are other important chemical contributions, including Prof. Milbauer's work on the corrosion of iron with CCl_4, and a paper by Prof. Heyrovsky and V. Nejedly—Part XVII of the Polaroraphic Studies with the Dropping Mercury Cathode.

This special number of the *Collection* is sold at 40 Czech crowns (5 shillings), whilst the annual subscription is £1 (or 170 crowns).

Sell's Directory. Business Publications, Ltd., 8 & 9, Johnson's Court, London, E.C.4.

The forty-sixth edition of *Sell's Directory of Registered Telegraphic Addresses* has just made its appearance and it comes to us in somewhat new guise. The cover is resplendent in its wealth of colour display, and several pages within are effective in design and colouring. We hardly recognise this old friend of business.

Within the bright covers there is to be found a mass of useful information such as the office, factory and library cannot reasonably afford to dispense with. Manufacturers and merchants, through the help of this medium, will find fresh channels to explore for the purpose of trade expansion, as its ramifications cover the whole of Great Britain and Ireland.

Nobody in this wide area whose name appears upon the official lists snpplied to the publishers by authority of H.M. Postmaster is excluded. Therefore it is obvious that in such a collection of names, addresses and details concerning responsible business houses, we possess a means of expediting commercial relationship.

The 1931 issue contains some 100,000 registered Telegraphic Addresses, as against the meagre 5,000 which served their useful purpose some 40 years ago. We observe it contains many advertisements in colour, but it is, in addition, replete with other information designed to facilitate the labours and increase the profits of the busines com-

munity, and although far more crowded with valuable data and business announcements than ever before, it is quite a convenient size. With the help of *Sell's Telegraphic Directory* the machinery of trade should be capable of better results.

OFFICIAL PUBLICATIONS RECEIVED.

UNITED STATES DEPARTMENT OF COMMERCE, BUREAU OF STANDARDS.

Plain and Thread Plug and Ring Gage Blanks. Commercial Standard CS8-30. Price 15 Cents.

Feldspar. Commercial Standard CS23-30. Price 5 Cents.

Manufacture of Insulating Board from Cornstalks. By O. R. Sweeney and W. E. Emley. Miscellaneous Publication, No. 112. Price 10 Cents.

Specifications for the Manufacture and Installation of Railway Track Scales for light Industrial Service. Circular of the Bureau of Standards, No. 386. Price 5 Cents.

The X-ray Method Applied to a Study of the Constitution of Portland Cement. By L. T. Brownmiller and R. H. Bogue. Research Paper No. 233. Price 10 cents.

The Isolation of the Isomers of Hexane from Petroleum. By J. H. Bruun and M. Hicks-Bruun. Research Paper No. 239. Price 10 cents.

Determination of Carbon in High Sulphur Steels by Direct Combustion. By H. A. Bright and G. E. F. Lundell. Research Paper No. 240. Price 5 cents.

A Study of the Method for Titrating Aldose Sugars with Standard Iodine and Alkali. By G. M. Kline, and S. F. Acree. Research Paper No. 247. Price 10 cents.

The Freezing Point as a Fixed Point on the International Temperature Scale. By H. T. Wensel and W. E. Roeser. Research Paper No. 258. Price 5 cents.

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Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Monday, March 16, at 8 p.m.—(Cantor Lecture) " Sound Recording and Reproducing Machines and their Development." By Captain A. G. D. West, of the Gramophone Company Ltd., (Lecture II).

Wednesday, March 18, at 8.30 p.m.—(Trueman Wood Lecture) " Some Aspects of Inter-Imperial Trade." By Lieut.-Gen. Sir William Furse, K.C.B., D.S.O.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Satuday, March 14, at 3 p.m—" Alpha-Rays. By Sir Ernest Rutherford.

Tuesday, March 17, at 5.15 p.m.—"Cytological Theory of Heredity." By C. D. Darlington.

Thursday, March 19, at 5.15 p.m.—" Respiration." By F. B. S. Haldane.

Friday, March 20, at 9 p.m.—" Sound, Sand and Smoke." By E. N. da C. Andrade.

MANCHESTER CHEMICAL SOCIETIES.

INSTITUTE OF RUBBER INDUSTRY.

Thursday, March 19, at 7 p.m. in The Manchester, Ltd., Royal Exchange. —" Some Problems in Sponge Rubber Manufacture." By S. A. Brazier, M.Sc., F.I.C., F.I.R.I.

INSTITUTE OF CHEMISTRY.

Friday, March 20, at 7 p.m. in The Manchester, Ltd., Royal Exchange, Prof. R. M. Caven, D.Sc., F.I.C. Annual General Meeting and Lecture. Members only.

THE INSTITUTE OF METALS.

BIRMINGHAM LOCAL SECTION.

Tuesday, March 17, at 7 p.m. in the Chamber of Commerce, New Street, Birmingham.—" The Metallurgy of Some of the Rarer Metals." By C. J. Smithells, M.C., D.Sc.

THE PHYSICAL SOCIETY.

Friday, March 20, at 5 p.m. at the Imperial College of Science, Imperial Institute Road, South Kensington. Annual General Meeting.

PRAGUE SUMMER SCHOOL.

July 20—August 8, at the Prague Summer School, during the long vacation there will be delivered lectures in English in a number of subjects including Literature, Art and Science in Czechoslovakia, the History and Geography of Central Europe, and there will also be language courses in German, Czechoslovak and Russian.

Particulars of the fees for one, two or three weeks, reduced railway fares and other factilities and excursions in connection with the course may be obtained from Dr. B. Trnka, 55, Smetana Square, Prague, Czechoslovakia.

ROYAL MICROSCOPICAL SOCIETY.

B.M.A. House, Tavistock Square, W.C.1.

An Ordinary Meeting of the Society will be held in the Hastings Hall at the above address on Wednesday, 18 March, at 5.30 p.m. The following papers will be read and discussed :—

" Microscopical Studies in Pernicious Anæmia.—III. The Macropolycyte. IV. Nuclear Degeneration in Blood Stream Cells." By Dr. W. E. Cooke, M.D., F.R.C.P.E., D.P.H., F.R.M.S., and C. F. Hill.

"Micro-polarising Crystals and their Projection."

The Biological Section will meet in the Pillar Room on Wednesday, 1 April. Hon. Secretary of the Section : Mr. D. J. Scourfield, I.S.O., F.L.S., F.Z.S.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

4,962.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of hydroxy-thionaphthenes, etc. February 17.

5,032.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of basic dyestuffs. February 17.

5,531.—I. G. Farbenindustrie Ake.-Ges. —Manufacture of salts of acylamino-phenol-arsenic acids. February 21.

Specifications Published.

343,006.—Soc. of Chemical Industry in Basle.—Manufacture of azo-dyestuffs.

343,397.—Chemische Fabrik Vorm. Sandoz.—Process for the manufacture of easily soluble salts of benzyl morphine.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

DETTOL.

519,938.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes. — Reckitt and Sons, Ltd., Kingston Starch Works, Damson Lane, Hull. February 25.

KILAMIC.

519,937.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes. — Murphy and Son, Ltd., Wheathampstead House, Wheathampstead, Hertfordshire. February 25.

SANDOZOL.

516,847.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. — Chemical Works Formerly Sandoz, also trading as Chemische -Fabrik -Vormals -Sandoz, and Fahrique De Produits Chimiques Ci-Devants Sandoz, 60, Fabrikstrasse, Basle, Switzerland. February 25 (Associated).

ZIPOFF.

519,433.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. — Glazebrooks, Ltd., Tyseley Paint and Varnish Works, James Road, Tyseley, Birmingham. February 25.

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THE LIVES AND ACHIEVEMENTS OF THE GREAT CHEMISTS.

From among several hundreds of manuscripts submitted for the "Francis Bacon Award for the Humanizing of Knowledge" the essay of Prof. Jaffe upon the lives of the Great Chemists and entitled "Crucibles" was selected for the prize of £1,500. The reader may therefore confidently expect a work of definite value and an attractive exposition of the contributions of the great scientific pioneers in chemistry, who, through the ages, have built up the present stock of human knowledge and thereby added to the culture and comfort of modern life.

Prof. Jaffe, we are told, spent four years on his volume of over 300 pages with chapters devoted definitely to sixteen outstanding figures in the history of chemistry from Bernard Trevisan (1406-90) to Mme. Curie, Sir J. J. Thomson and Prof. Irving Langmuir. Naturally he has introduced details of the work and lives of dozens of other eminent men in the course of his clear account of the discoveries of those whose biographies he has actually selected as the subjects for the chapters of his book.

The lives of these men of science are so portrayed and their researches so described that the book is well within the reach of the public. Indeed, it would seem as though Prof. Jaffe's object was to command the attention of the non-scientific world with his discourse upon the achievement of the pioneers in the investigations of natural phenomena.

The scientific reader too will delight to read the wealth of anecdotal details of the careers of those whose names are familiar as the builders of chemical science. The sources from which Prof. Jaffe has drawn are given at the end of the book but, except for a few notes, the anthority for work from which the information was taken has not been indicated. He has included in his bibliography a very comprehensive list of the works on the history of science in general and of chemistry in particular and has included references to many epoch-making original memoirs of recent times. For his account of alchemy he has selected the lives of Trevisan and Paracelsus and the works and times of these pioneers are well

Crucibles. By PROF. B. JAFFE. Pp 318. London : Jarrolds, 34, Paternoster Row, E.C. 1931. Price 18s.

portrayed and their contributions to early chemistry are fairly estimated. For an account of the beginnings of chemical theory based upon direct observation the chequered life and ideas of Becher has been chosen for discussion. Whilst the story of this seventeenth century experimenter is described in great detail little reference is made to the support he obtained for his Phlogiston Theory from Stahl, without whom it is doubtful whether the theory would have survived so long, particularly in an age when Robert Boyle and the other distinguished Fellows of the newly founded Royal Society were instituting an era of *experimental science upon* which alone were scientific generalisations and theories to be based.

The discoveries of Joseph Priestley and of Henry Cavendish form the subjects of two chapters which are followed by one on *Lavoisier and his efforts to clarify* chemistry by a more rational system of nomeclature and a correct appreciation of the phenoma of combusion, all of which were the outcome of the discovery of oxygen by Priestley and independently by Scheele in Sweden, together with Cavendish's work on hydrogen and its production of water on burning.

With John Dalton and the enunciation of the Atomic Theory at the commencement of the last century, modern chemistry may be said to have definitely begun. Its stabilisation by the analytical work of Berzelius and the development of Organic Chemistry by Woehler and Liebig are portrayed by Prof. Jaffe who then goes on to indicate the eventual appreciation of Avogadro's Hypothesis and his clear exposition of the distinction between Atoms and Molecules. With an account of the valuable contributions of Mendeleef and of Arrhenius to the further development and explanation of chemical phenomena the author brings his work down to modern times for, with the exception of H. G. J. Moseley, the subjects of his last few biographies are still happily with us, contributing to the fluctuation of the problems of science still unsolved and guiding others to the same end.

Whilst the names of many other distinguished contributors to the advancement of chemistry will occur to the men of science who peruse the chapter headings of Prof. Jaffe's book, it will be found that these have not been altogether forgotten and their achievements are, in the main, recorded in the appropriate places in the book, which by its very nature must be to some extent selective. Many will regret, however, the rather cursory references to the monumental researches of Pasteur, Urbain, Faraday, Ramsay and Crookes, among others. There is, however, so much within the covers of this volume that criticism of any omission must be expressed with great diffidence. One or two points in the text might call for comment. It would be interesting to know the source for the statement (p. 69) that Cavendish obtained hydrogen from by the action of sulphuric acid on tin, and again (p. 113) "Berthollet . . . as late as 1890 still wrote the formula for water as if it were hydrogen preoxide."

In the chapter on Woehler, Kekulé is credited with dreaming his formula for benzene whilst at Ghent whereas Kekulé himself declared that the idea came to him when returning on top of a bus to his temporary home at Clapham. These, nevertheless, are very minor points in comparison with the valuable contribution Prof. Jaffe has made to the critical literature on the history of chemistry.

J.G.F.D.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

APPLICATIONS FOR LICENCES IN FEBRUARY, 1931.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during February has been furnished to the Board of Trade by the Dyestuffs Advisory *Lincensing Committee.*

The total number of applications received during the month was 485, of which 407 were from merchants or importers. To these should be added 29 cases outstanding on the 31 January ,1931, making a total for the month of 514. These were dealt with as follows :—

Granted—462 (of which 449 were dealt with within 7 days of receipt).

Referred to British Makers of similar products—52 (of which 38 were dealt with within 7 days of receipt).

Of the total of 514 applications received, 487 or 95 per cent. were dealt with within 7 days of receipt.

THE NERNST EQUATION.
I. A NEW EQUATION FOR ELECTRODE POTENTIALS.

By Martin Meyer.

Introduction.

Nernst's familiar equation

$$E = \frac{0.0002\,T}{Ne} \log \frac{P}{p}$$

where E is the E.M.F. in volts; Ne is the valence of the ion; T is the absolute temperature, and P and p are the electrolytic solution pressure and tension respectively for a single electrode, does not give values which are in good agreement with observations, either for single electrode potentials or for cells.

Many corrections have been applied to the concentration of the " active " material in an effort to secure better agreement. As is illustrated here, all save the " activity " coefficient fail. Current textbooks, however, still make curious comments about the equation.[1] Since electromotive force measurements may be made with as great precision as any measurements in chemistry, it may be of interest to examine some, and also another possible equation which, however, because of its nature, seems only of academic interest.

The literature contains much carefully performed work of this nature and study of it leads to the conclusion that in all cases there is a consistent divergence of experiment and formula. Take the generally accepted excellent work of Ellis.[2] It presents the observed values of the hydrogen electrode at 18° C. Fig. 1 shows the graph of the observations in Curve 1, Nernst's in Curve 2, and the differences against the concentration in Curve 3. The ordinates for the last are at the right. The calomel electrode is taken as -0.560 at 18° C.

From this two conclusions may be drawn :

1. Nernst's equation does not accurately represent the potentials.

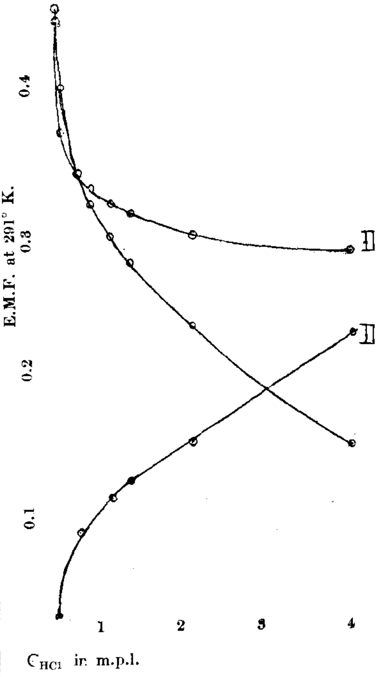

Fig. 1.

2. The variation appears to be a regular mathematical function of the concentration.

Illustrating the effect of the various corrections which have been applied the following table is given. It is taken from Ellis' work just given as far as observations are concerned, but the various calculations were made by the writer. It includes the data from which Fig. 1 was made.

---

[1] *Cf.* Morgan, *Elements of Physical Chemistry*, p. 424 *et seq.*

[2] J. H. Ellis, *J.A.C.S.*, 1916, xxxviii, 785.

CHCl in moles per 1000g. H_2O (Ellis)	E 18° C. (Ellis)	CHCl moles per litre	C_{H^+} from[3] conductance	C_{H^+} including[4] viscosity correction	Corrected obs. value E 18° C. Curves 1, 2, 3, 4	E calc. Nernst Eq.	Difference
Curve 4		Curve 1	Curve 3	Curve 2		Curve 5	Curve 6
4.484	0.15759	4.1044	1.648	(1.310)	-0.4398	-0.6107	0.1709
1.9278	0.23769	1.8535	1.242	(1.107)	-0.5199	-0.6309	0.1110
1.0381	0.27919	1.0159	0.8069	0.8770	-0.5622	-0.6456	0.0834
0.77137	0.29654	0.7587	0.6286	0.6623	-0.5787	-0.6534	0.0747
0.50948	0.31912	0.50345	0.4285	0.4534	-0.6011	-0.6631	0.0620
0.33757	0.33845	0.3346	0.2975	0.3038	-0.6206	-0.6753	0.0547
0.10040	0.39764	0.09999	0.0925	0.0907	-0.6798	-0.7020	0.0222
0.03332	0.45020	0.03324	0.03266	0.03235	-0.7324	-0.7324	0.0000
0.01001	(0.5271)						
0.003333							

[3], [4] Values for conductance and viscosity taken from Mellor, *Inorganic Chemistry*, Vol. 2. p. 1910.

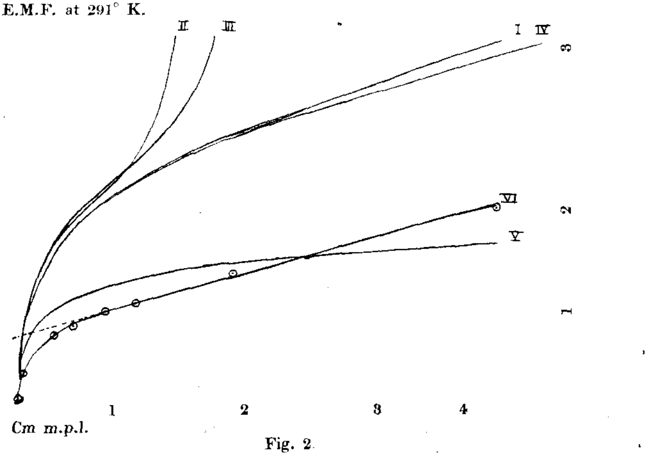

Fig. 2.

Figure 2. is a graphic illustration of these values. Curves 1, 5 and 6 are the same as 1, 2 and 3 in Figure 1 plotted slightly differently. The dotted line in curve 6 is intended to emphasise the line nature of a portion of the curve in connection with a formula about to be given, and curve 8 in Fig. 1 has similarly been slightly flattened. The difference curve ordinates are again given at the right, and except for this curve the location of points has been omitted to avoid confusion. The difference is 0 at one concentration merely because the constant of the Nernst Equation was determined at that point.

It is evident that none of these curves approaches the theoretical one, and in some corrections the very form of the curve itself is altered.

The New Equation.

These variations are just what should be expected in view of the fact that Nernst's Equation is derived from an application of

the Ideal Gas Law to the very situation where it would least be expected to apply. The form of this derivation will be given in a moment in the new derivation so it need not be repeated here. In solution we are dealing with ions certainly far below their critical temperatures and at osmotic pressures relatively great.

There are equations which approximate the behaviour of substances under these adverse conditions with greater precision : Van der Waal's :

$$(p+\frac{a}{v^2})\ (v-b)=nRT$$

Dieterici's[5] :

$$p=\frac{nRT}{v-bl}-\frac{a}{VRT}$$

One of these, or others, employed instead of the Ideal Gas Laws following the form of the Nernst derivation should give an expression for these potential differences which is much more valid. The writer has made derivations for others. For Van Der Waal's Equation this derivation follows.

Where the ions of a substance are introduced into a constant volume V against pressure the osmotic work may be represented as :

$$W=\int_p^P v\,d\,p$$

Employing Van der Waal's Equation, making a change in variables for ease in computation, let

$y=p=$pressure.
$A=RT$ $T=$absolute temperature $R=$gas constant $=$ 1.985 or 2 calories.
$b=b$ $=4$ times the actual or incompressible volume of the gas molecules.
$c=a$ $=$attraction of the molecules.
$x=v$ $=$volume.
$m=p$ } limits $=$solution pressure of the metal
$n=P$ } limits $=$solution tension of the ion, roughly 22.4 times its molar concentration.

Transforming the above equations into this new notation, we have, solving,

[5] F. H. Macdougal, *J.A.C.S.*, 1916, XXXVIII, 528.

$$y=\frac{a}{x-b}-\frac{c}{x^2}$$

$$w=\int_{y_1=m}^{y_2=n} x\,dy.$$

$$dy=(-\frac{a}{(x-b)^2}+\frac{2c}{x^3})\ dx$$

$$\int xdy=\left[-\frac{2c}{x}\right]_{y_1}^{y_2}-\int_{y_1}^{y_2}\frac{ax\ dx}{(x-b)^2}$$

By splitting up the second term it is obvious that it may be integrated to

$$\frac{ab}{x-b}-a\log(x-b)$$

Hence we have

$$W=\left[\frac{ab}{x-b}\cdot\frac{2c}{x}-a\log(x-b)\right]_{y_1}^{y_2}$$

We must now determine our limits. To do this these cubics must be solved :

$$\frac{a}{x_2-b}-\frac{c}{x_2^2}=n \qquad (1)$$

$$\frac{a}{x_2-b}-\frac{c}{x_1^2}=m \qquad (2)$$

The form of solution for both will be the same. Clearing of fractions and diminishing the roots properly, they may be put in the form

$$y^3-Ly-Q=o$$

if $y=x-K$

where $K=\frac{bn+a}{3n}$ (similarly for m)

The cubic $x^3+px+q=o$ has by Cardan's Theorem, three roots

$$x_1=\sqrt[3]{A}+\sqrt[3]{B}$$
$$x_2=\omega\sqrt[3]{A}+\omega^2\sqrt[3]{B}$$
$$x_3=\omega^2\sqrt[3]{A}+\omega\sqrt[3]{B}$$

where $$A = -\frac{q}{2} + \sqrt{\frac{q_2}{4} + \frac{p_3}{27}}$$

$$B = -\frac{q}{2} + \sqrt{\frac{q_2}{4} + \frac{p_3}{27}}$$

This discriminant here is $\frac{Q_2}{4} - \frac{L_3}{27}$

In terms of the original problem

$$L = \frac{(bP+RT)^2 - 3aP}{3P^2}$$

$$Q = \frac{2(bP+RT)^3 - 9Pa(bP+RT) + 27P^2ab}{27P^3}$$

$$K = \frac{bp+RT}{3P}$$

As $a=o$ and $b=o$

$$Q = \frac{2(RT)^3}{27P^3}, \quad L = \frac{(RT)^2}{3P^2} \text{ and } K = \frac{RT}{3P}$$

$$\text{Discriminant} = \left(\frac{RT}{3P}\right)^6 - \left(\frac{RT}{3P}\right)^6 = 0$$

Assume that *it* approaches *O from* the negative side when all roots will be real and unequal and $\sqrt{\Delta}$ is imaginary.

Then $$A = \frac{Q}{2} + \sqrt{\frac{Q^2}{4} - \frac{L^3}{27}}$$

$$B = \frac{Q}{2} - \sqrt{\frac{Q^2}{4} - \frac{L^3}{27}}$$

and these values may be substituted above.

For A, and B, we have similar expressions in a new Q, L and K for the lower limit which involves p the electrolytic solution pressure of the metal.

The equation given above is the irreducible case of the cubic :

$$A = \frac{Q}{2} + i\sqrt{\frac{L^3}{27} - \frac{Q^2}{4}}$$

$$B = \frac{Q}{2} - i\sqrt{\frac{L^3}{27} - \frac{Q^2}{4}}$$

$$A = r(\cos\theta + i\sin\theta)$$
$$B = r(\cos\theta - i\sin\theta)$$

where

$$r = \left(\frac{L^3}{27}\right)^{\frac{1}{2}} \text{ and } \cos\theta = \frac{Q}{2}\left(\frac{27}{L^3}\right)^{\frac{1}{2}}$$

and

$$x_1 = 2r^{\frac{1}{3}} \cos\frac{\theta}{3} + K$$

$$x_2 = 2r^{\frac{1}{3}} \cos\frac{\theta+2\pi}{3} + K$$

$$x_3 = 2r^{\frac{1}{3}} \cos\frac{\theta+4\pi}{3} + K$$

And $x'_1 = 2r_1{}^{\frac{1}{3}} \cos\frac{\theta_1}{3} + K_1$ etc.

Therefore

$$\text{Osmotic Work} = \left[\frac{RTb}{2r^{\frac{1}{3}}\cos\frac{\theta}{3} - b + K} - \frac{a}{\left(2r^{\frac{1}{3}}\cos\frac{\theta}{3} + K\right)^2} - RT\log\left(2r^{\frac{1}{3}}\cos\frac{\theta}{3} - b + K\right)\right]$$

$-$ [similar expression with r_1 and θ_1] or

$$\text{Osmotic Work} = \left[\frac{RTb}{2r^{\frac{1}{3}}\cos\frac{\theta}{3} - b + K} - \frac{RTb}{2r_1{}^{\frac{1}{3}}\cos\frac{\theta}{3} - b + K_1} + \frac{a}{\left(2r_1{}^{\frac{1}{3}}\cos\frac{\theta}{3} + K_1\right)^2} - \frac{a}{\left(2r^{\frac{1}{3}}\cos\frac{\theta}{3} + K\right)^2} + RT\log\frac{2r_1{}^{\frac{1}{3}}\cos\frac{\theta}{3} + K_1 - b}{2r^{\frac{1}{3}}\cos\frac{\theta}{3} + K - b}\right]$$

There is a possibility of two other osmotic work expressions involving the other roots. They will be similar in form save for the value of the cosine of the angle.

Now, Electrical Work =

$$Ne \times 96500 \times E.M.F.$$

= Osmotic Work in the same units.

Therefore

$$E.M.F. = \frac{4.184}{96500\ Ne}[\text{Osmotic Work integral}]_3$$

or briefly

E.M.F. = ϕ[O.W.] as above, where ϕ stands for the numerical coefficient.

This is a new expression for potentials.

To test out the validity of the reasoning, when a = o and b = o, θ = o and this expression becomes

$$E.M.F. = \phi\left[Rt\ \log\frac{2\left\{\frac{RT}{3P}\right\}+\frac{RT}{3P}}{2\left\{\frac{RT}{3P}\right\}+\frac{RT}{3P}}\right]$$

$$= \phi RT\ \log\frac{P}{p}$$

which is Nernst's equation.

If we can assume a = o as in the case of gaseous hydrogen if our constants have the same significance as Van der Waal's,

$$Q = \frac{2(bP+RT)^3}{27P^3}$$

$$K = \frac{bP+RT}{3P}$$

$$L = \frac{(bP+RT)^2}{3P^2}$$

$$r = \left\{\frac{bP+RT}{3P}\right\}^3$$

$$\cos\theta = 1$$

The first set of roots are then the ones we want as these give the expression for maximum work

$$E.M.F. = \phi\left[\frac{RTB}{2\left\{\frac{pP+RT}{3P}\right\} - b + \frac{bP+RT}{3P}}\right.$$

— same for p

$$\left. + RT\ \log\frac{2\left\{\frac{bp+RT}{3p}\right\} - b + \frac{bp+RT}{3p}}{2\left\{\frac{bp+RT}{3p}\right\} - b + \frac{bp+RT}{3p}}\right]$$

$$E.M.F. = \phi\left[Pb - pb + RT\ \log\frac{P}{p}\right]$$

Hence

$$E.M.F. = \phi\left[b(P-p)+RT\ \log\frac{P}{p}\right]$$ for a single electrode

$$E.M.F. = \phi\left[b(P-P^1)+RT\ \log\frac{P}{P^1}\right]$$ for a concentration cell,

and $$f = \frac{E.M.F. - \phi RT\ \log\frac{P}{p}}{\phi(P-p)}$$ should be a constant for any substance where a can be assumed = o, as perhaps hydrogen.

SUMMARY.

1. Some electromotive force data have been graphically examined.

2. A new equation for electromotive force has been derived and a prediction based upon this derivation has been made.

Brooklyn College,
College of the City of New York.
New York City.

BRITISH TRADE BALANCE IN 1930.

The annual estimate of the net balance on all transactions of a revenue character between the United Kingdom and other countries shows for 1930 a credit balance of £39 million. This compares with similar balances of £138 million for 1929 and of £137 million for 1928.

GENERAL NOTES

CANADA'S PART IN GEODETIC UNION WORLD CONGRESS.

Geodetic Triangulation, Levelling, and Research Work.

Canada took a prominent part in the deliberations at the Fourth General Congress of the International Geodetic and Geophysical Union held at Stockholm, Sweden, last autumn. Mr. Noel J. Ogilvie, D.L.S., M.E.I.C., Director of the Geodetic Survey of Canada, Department of the Interior, and Chairman of the National Committee of Canada of the International Geodetic and Geophysical Union, was the official representative. Other delegates were Mr. W. E. W. Jackson, Assistant Director, Meteorological Service, Department of Marine and Fisheries, Toronto, and Professor E. L. Bruce, Queen's University, Kingston, Ontario.

The International Geodetic and Geophysical Union is divided into the following sections :—Geodesy, Oceanography, Seismology, Meteorology, Volcanology, Terrestrial Magnetism and Electricity, and Scientific Hydrology. The object or purpose of the Union is to promote the study of problems relating to the shape and physics of the earth; to initiate and organize the conduct of researches which depend on co-operation between different countries and provide for their scientific discussion and publication; to facilitate particular researches, such as the comparison of instruments and methods used in different countries. The National Committee of Canada of the Union was formed in 1920.

The initial meeting of the General Assembly was opened by the President of the National Committee of Sweden in the Concert House at Stockholm, and the remaining meetings were held in the Parliament House adjoining the Royal Palace. The Section of Geodesy, being the largest of the several sections belonging to the Union, occupied one of the two principal chambers.

The delegates numbered 250, representing forty-two countries. Seven countries were reported as recently adhering to the Union while German representatives were present for the first time since the World War. An outstanding feature of the Congress was the presentation of national reports. Canada submitted a statement of progress of geodetic operations in the Dominion since the previous meeting of the Union.

In this record for the period from January 1, 1927, to December 31, 1929, it was shown that important progress in first-order triangulation with its allied operations—the measurement of first-order base lines and the determination of Laplace stations—and in first-order levelling, first-order traverse, geodetic astronomy, and isostasy had been made. Special activity was noted in mathematical research, and in the publication of geodetic results.

It was reported that during the year 1929 very successful use was made of aeroplanes in triangulation operations, including the selection of routes for triangulation nets, the actual selection of triangulation stations, and the transportation of observing and other parties from point to point. In all more than 300 hours were flown for the Geodetic Survey of Canada during the year 1929. So far as is known the first application of aerial methods to geodetic operations in any country was carried out in Canada by an officer of the Geodetic Survey in 1921.

During the period 1927-29 inclusive, steady progress was recorded on the various parts of the control net of Canada. At the end of 1929 the area of completed first-order triangulation was about 187,000 square miles, of which some 83,000 square miles was completed in the three years 1927-1929 inclusive. On an additional 42,000 square miles the reconnaissance, or selection of stations has been finished. The first-order triangulation nets have had 1,767 miles added to their length, as against 1,441 miles in the previous three-year period, making a total length to date of about 6,800 miles of primary control.

A total of 2,564 miles of levelling was added to the Canadian level net, 1,614 miles of this being designated as precise levelling and 950 miles as secondary. The precise levels have been carried almost exclusively along railway tracks while the secondary levels, on the other hand, have in general been carried along the highways.

Other work included the following :—Seven first-order base lines were measured for control of lengths of triagulation. Fifteen triagulation stations have been occupied as Laplace stations (longitude and azimuth), thirty-five triagulation stations were observed for longitude and latitude for deflection of the vertical and isostasy investigations, and the longitude and latitude

were determined at five stations on the Manitoba-Ontario boundary line and on Hudson bay in the vicinity of Churchill. The adjustment of precise level lines in Canada was continued, until, at the end of the period, what is called the 1928 Adjustment was completed. This is the ninth in the series of adjustments carried out and embraces all precise levelling done in Canada up to the end of the season 1928.

SECOND INTERNATIONAL CONGRESS OF THE HISTORY OF SCIENCE AND TECHNOLOGY.

The Second International Congress of the History of Science and Technology will take place in London, from Monday, June 29 to Friday, July 3, 1931, with the Science Museum, South Kensington, as its headquarters. Dr. Charles Singer will be the President.

The Congress originated with the *Comité International d'Histoire des Sciences* which was founded at Oslo on August 17, 1928. This body meets annually in Paris and organises every three years a Congress in which persons interested in the History of Science and Technology are invited to take part. For the coming Congress the Comité has been fortunate in enlisting the co-operation of its parent body the *Comité International des Science Historiques* together with that of two other international Societies the *History of Science Society*, Washington D.C., and the *Newcomen Society for the Study of History of Engineering and Technology*, London. The aim of the Congress is to provide opportunity for intercourse and exchange of thought between all those who are interested in the various departments of the History of Science and Technology.

The programme will include morning sessions for the presentation and discussion of communications on the history of science and technology, afternoon visits to Kew Gardens, Down House, Greenwich, Barbers Hall, the Royal College of Physicians, the British Museum, the Natural History Museum and the National Portrait Gallery, excursions to Oxford and Cambridge, and social engagements in the evenings.

Further particulars can be obtained from the Honorary Secretary of the Congress, H. W. Dickinson, the Science Museum, South Kensington, London, S.W.7.

WORKERS TOUR OF CONTINENTAL FACTORIES.

Readers will learn with interest that the Auto-Strop Safety Razor, Company, Ltd., is one of five prominent firms who are associated with the Economic League in a project offering British workers an opportunity of studying industrial conditions abroad.

The fortunate workers will be selected by means of a prize essay competition which is restricted to bona-fide male workers in full employment and not less than 21 years of age. Entrants will be required to write a short essay on "How to Restore Britain's Industrial Prosperity." Literary expression will be considered second to practical ideas and reasons.

Successful competitors (about 25 in number it is hoped) will tour industrial centres in France, Belgium, and Germany. An effort will be made to include representatives of various trades and crafts, so that the benefits may be widespread. Full Hospitality, competant guidance, and free transportation will be provided throughout the ten days travel. In addition the prize winners will receive compensation at their normal rate of wages for time lost during the period of their absence.

Before leaving England the party will be given an opportunity of inspecting the establishments of the associated firms, including the Auto-Strop Safety Razor Company's up-to-date works in the City Road.

Sir Ernest Benn, Sir Francis Goodenough, and Mr. Archibald Crawford, K.C. (Director of the Economic League) will be the adjudicators.

Entry forms and conditions may be had on application to the Economic League, 2, Millbank House, London, S.W.1.

PALESTINE.

Appointment of Agents.

A confidential memorandum on the appointment of agents in Palestine prepared by the representative of the Department of Overseas Trade at Haifa has been received and issued by the Department to firms whose names are on its Spcial Register. British firms who desire to obtain a copy of the memorandum and particulars of the Special Register service should apply to the Department (Reference No. C.X. 3466 should be quoted).

BRITISH INDUSTRIES FAIR REVIEWED.

The total attendances at the British Industries Fair at Olympia and White City, London, and Castle Bromwich, Birmingham, are announced as follows :—

	Overseas Buyers	Home Buyers	Public
London	4,854	167,259	34,679
Birmingham	1,984	106,682	14,215
Totals	6,838	273,941	48,215

The total attendances of home buyers showed an increase of about 30,000 over last year's figures and the actual number of overseas buyers, not counting repeat visits, was up by over 25 per cent.

An analysis of the overseas buyers' cards for the London sections of the Fair showed that 75 countries were represented as compared with 70 last year. Out of 26 European countries, 21 sent more buyers than last year, three out of the remaining five sending the same number as before. Denmark sent three times as many buyers as last year and Czecho-slavikia twice as many. Other good increase were for Germany, Italy, Switzerland, Finland and Spain. Russia's representation was 22 as compared with one solitary buyer last year.

Near and Far East representation was up by 50 per cent. Of the Latin-American states, 16 were represented as compared with 12 in 1930, the only one sending fewer buyers being the Argentine where there is the British Trade Exhibition. There was a slight decrease in the number of buyers from the United States, Canada, Australia, New Zealand and South Africa.

The success of some firms in the chemical section was attributed to the strong recommendation of the Association of British Chemical Manufacturers, the organisers of the section, that principals of the firms should be available on the stands. This recommendation was widely followed, principals taking so many hours' duty regularly each day.

UNITED KINGDOM INDUSTRIAL PRODUCTION IN 1930.

The downward trend in the volume of production in the United Kingdom, as measured by the index number of manufacturing industries, continued into the fourth quarter of 1930. The index number for the whole year is 103.3, as compared with 111.8 for 1929 and 105.5 for 1928.

EXEMPTIONS FROM KEY INDUSTRY DUTY.

The Treasury have made an Order under Section 10 (5) of the Finance Act, 1926, exempting acid isobutyl allyl barbituric; acid propionic; butyl methyl adipate; calcium gluconate (calcium glyconate); chinoline (quinoline); strontium carbonate; strontium nitrate, from Key Industry Duty from 3 Febrnary, to 31 December, 1931.

The Treasury Order will shortly be published by the Sationery Office.

RUSSIAN TRADE REPRESENTATION IN THE UNITED KINGDOM.

The Soviet Ambassador has informed His Majesty's Government that Mr. Saul G. Bron has left London on a temporary visit to Moscow, and that in his absence Mr. Victor Karpoff will act as Trade Representative of the U.S.S.R. *ad interim.*

VISIT OF H.M. TRADE COMMISSIONER AT JOHANNESBURG.

The Department of Overseas Trade announce that Mr. J. W. Brigden, H.M. Trade Commissioner at Johannesburg, who acted as Secretary to the United Kingdom Trade Mission which visited the Union of South Africa and Rhodesia last autumn under the chairmanship of the Rt. Hon. Lord Kirkley, is now in this country on an official visit.

Mr. Brigden will be available at the offices of the Department during the period March 16 to 24 to interview manufacturers and merchants interested in the export of British goods to South Africa. He will also visit a number of industrial centres in the Provinces.

BRITISH PASSENGER MOVEMENT BY SEA IN 1930.

Returns for last year show that the outward balance of British passengers by sea from the United Kingdom to non-European countries was 23,540, as compared with 92,537 in 1929. The net movement to British North America showed a decrease of 40,558 and that to the United States a decline of 8,380, while in place of a net outward movement to Australia of 7,547 in 1929 there was an inward one of 6,043 last year.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

March 5, 1931.

The following papers were read :—

The Kinetics of the Combination of Hydrogen and Oxygen : the Influence of Iodine. By W. L. GARSTANG and C. N. HINSHELWOOD, F.R.S.

The position of the investiagtion of the reaction between hydrogen and oxygen is summarised and additional data recorded about certain points previously studied.

The surface reaction in vessels of silica and porcelain is found to be accelerated by iodine.

The gas reaction occurring at relatively high temperatures and pressures is found to be retarded and the explosion which normally occurs between certain limits of pressure to be inhibited. The amounts of iodine required are small. The efficiency of collisions with iodine in breaking chains is, however, found to be less than 10^{-4}.

Water vapour is found to lower the upper critical limit of the low pressure explosion region, and, in sufficient amount, to inhibit the explosion altogether.

Commercial hydrogen appears to contain no inhibiting substances.

The action of other halogens on the reaction and also the inhibition of the oxidation of hydrocarbons is being studied.

Optical and Equivalent Paths in a Stratified Medium, treated from a Wave Standpoint. By D. R. HARTREE. Communicated by E. V. Appleton, F.R.S.

The limitations of a ray treatment of the reflection and refraction of electromagnetic waves by a stratified medium are discussed, and it is shown that a wave treatment is essential for the interpretation of some of the phenomena of reflection from the Heaviside layer.

Expressions for the optical and equivalent path in terms of the solutions of the equations of wave propagation are obtained, both for normal and oblique incidence, and exact expressions are obtained for the optical path for normal incidence on stratified media with certain simple variations of refractive index. It is shown that for a medinm totally reflecting at normal incidence the difference between the optical path deduced from a wave and from a ray treatment is not likely to be greater than a wave-length *in vacuo*, although at the height at which $\mu^2=0$ the conditions for application of a ray treatment are not satisfied.

Approximate expressions are obtained for optical and equivalent paths in any totally reflecting medium in which μ^2 varies sufficiently slowly.

The Adsorption of Substances by Fuller's Earth. By H. J. PHELPS. Communicated by C. N. Hinshelwood, F.R.S.

The adsorption of weak solutions of various organic acids and bases has been studied. In particular attention is directed to a study of the adsorption of such substances from solutions of various hydrogenion concentrations. Propionic and hexoic acids are not adsorbed under any conditions. Oxalic acid is adsorbed in solutions more alkaline than pH3, probably it is adsorbed as calcium oxalate. The bases *n*-propylamine and *n*-butylmine are adsorbed strongly in solutions more alkaline than pH9. These substances are also adsorbed to a less degree in solutions of " reaction " between pH9 and pH4. It has been found that the adsorption of *n*-propylamine in approximately neutral solution causes the displacement of an equivalent amount of calcium from the fuller's earth surface. It is concluded, therefore, that the adsorption of the simple amines is molecular, or " apolar " in solutions of reaction more alkaline than pH9, while it is ionic, or " polar " in solutions more acid than about pH8. This view is supported by the fact that synthetic aluminium silicate gel adsorbs *n*-butylamine only in solutions more alkaline than pH7-8. The fact that the adsorption of the bases and also that of oxalic falls to zero in solutions more acid than pH3, is attributed to the fact that the calcium salts in the fuller's earth, the presence of which is essential for adsorption to take place, are soluble under these conditions.

The following papers were read in title only :—

The Arithmetically Reduced Indefinite Quadratic Form in n Variables. By L. J. MORDELL, F.R.S.

A simple method is given for finding inequalities satisfied by the coefficients of a reduced indefinite form. When the coefficients are integers a simple proof is given that the class number for forms with given determinant in finite. A normal type is also found for the reduced forms.

The Kinetics of Reactions in Solution I, II. By A. E. MOELWYN-HUGHES AND C. N. HINSHELWOOD, F.R.S.

The decomposition of chlorine monoxide in carbon tetrachloride solution proceeds at the same rate, possesses the same heat of activation, and apparently takes place by the same mechanism as in the gaseous state.

The retardation of bimolecular reactions by solvents, which has sometimes been revealed by the comparison of the observed rates of reactions in solution with the rates calculated theoretically for the corresponding gas reactions, thus appears to depend upon a specific influence of particular solvents, and need not occur in an " ideal " solution.

The aim of the experiments was to determine whether constancy of rate and heat of activation with change of solvent can be regarded as the usual characteristic of a unimolecular reaction. It is concluded that it is only true of certain " ideal " solvents. In fine solvents the rate of decomposition of trinitrobenzoic acid varies widely, and the heat of activation changes by as much as 10,000 calories. The rate of reaction in water in only slightly influenced by hydrogen-ion concentration, but in certain solvents the rate of reaction and heat of activation change profoundly with the degree of purity of the solvent.

The Effect of Combined Electric and Magnetic Fields on the Helium Spectrum—II. By J. S. FOSTER. Communicated by A. S. Eve, F.R.S.

The Upper Limit of Energy in the Spectrum of Radium E. By F. R. TERROUX. Communicated by Lord Rutherford, F.R.S.

The velocities of the fastest β-rays from Radium E were determined from the curvature of the tracks in a magnetic field and the distribution of the rays obtained in the region extending from 4,000 to 10,000 $H\rho$. The complete spectrum of Radium E was obtained by combining the present observations with previous work and the resulting curve shows no trace of the hitherto accepted end point at about 5,000 $H\rho$. On the contrary the spectrum appears to tail off very gradually and to extend at least as far as 12,000 $H\rho$, which corresponds to an energy of 3,000,000 electron volts. The number of particles above 5,000 $H\rho$ is estimated to be about 4 per cent. of the total number emitted. An energy distribution curve was obtained, and from this the average energy per disintegration is estimated at about 473,000 volts, with a probable error of 20 per cent., which is in fair agreement with the values obtained from heating measurements.

It appears probable that the β-particles from Radium E are emitted from the nuclei according to a simple distribution law which resembles the Maxwellian form, and that there is a finite probability for the emission of a particle with any velocity.

Investigations on the Spectrum of Selenium—I. By K. R. RAO AND J. S. BADAMI. Communicated by A. Fowler, F.R.S.

The spectrnm of selenium has been investigated from λ7,000-λ650, mainly using different intensities of discharge through capillary tubes containing vapour of selenium. Between λ1,400 and λ400, vacunm spark spectra have been taken with and without inductance.

With the aid of these data the doublet system of trebly-ionised selenium has been identified. A term scheme has been proposed based on a choice of 70,240 cm.$^{-1}$ for the term $5g^2G$. The largest term $4p^2P_2$ $=346,094$ cm.$^{-1}$ gives an ionisation potential of about 42.72 volts.

A few singlets and inter-combination lines in Se V have been added to the triplet system that was already known. The largest term, $4s^1S_0$, is found to be 589,781 sm.$^{-1}$, leading to an approximate ionisation potential of 72,8 volts.

Stark-Effect in Molecular Hydrogen in the Range 4,100-4,770A. By J. K. L. MACDONALD. Communieated by A. S. Eve, F.R.S.

The stark effect for 100 lines in the spectrum of moleeular hydrogen in the range 4,100-4,770A is investigated.

Certain complex structures reported by Kinti are resolved into independent lines.

Displacements of line components are measured and the observations are considered from a theoretical viewpoint. Certain groups of P- and R- branch lines with common initial levels are found to be adequately described as regards number and polarization of components, by a theory which is briefly discussed.

Enlarged reproductions of spectrograms are included in the paper.

The Reflection of Vapour Molecules at a Liquid Surface. By T. ALTY. Communicated by Sir Joseph Thomson, F.R.S.

The rate of evaporation from a water surface is measured as a function of the vapour pressure above the evaporating surface. By extrapolation to zero pressure the

rate of evaporation into a vacuum is found. On comparing this experimental result with the formula of the kinetic theory of gases for the number of vapour molecules striking a water surface per second from the saturated vapour, it appears that only about 1 per cent. of the molecular incident on the surface are able to enter the liquid. This is taken to indicate that there must be very pronounced reflection of water vapour molecules at the liquid surface.

THE CHEMICAL SOCIETY.

Thursday, March 5.

Studies of Valency. Part XV. Absorption Spectra of Polyhalide Ions. By F. L. GILBERT, MRS. R. GOLDSTEIN, AND T. M. LOWRY.

Molecular extinction-coefficient are recorded for 7 aromatic polyhalides of the series $BrC_6H_4 \cdot NMe_3+$ in alcohol, for 8 cæsium polyhalides in alcohol and in water and for a series of aqueous potassium polyhalides prepared by adding free halogens to the potassium halides.

The polyhalide ions from I_3' to $BrCl_2'$ give characteristic absorption spectra which cannot be attributed to hydrolysis, dissociation, reduction, or double decomposition.

Dissociation, which is specially marked is aqueous solutions, diminishes the intensity of the strong selective absorption of the ions, but does not change the form of the absorption curves of which the principal feauties are tabulated.

The Reactions of Substituted Ammonium Aryloxides and of Related Compounds. Part I. The Preparation and Thermal Decomposition of some Tetra-substituted Ammonium Aryoxides. By MISS R. V. HENLEY AND E. E. TURNER.

In order to obtain further insight into the processes governing the typical reactions of aryloxides, a number of tetra-substituted ammonium aryloxides have been prepared.

The Cinchona Alkaloids and Substances related to them. Introduction and Part I. Some Piperidinomethyl-carbinol Hydrochlorides. By MISS R. V. HENLEY AND E. E. TURNER.

The synthesis is described of a number of compounds of the type $Ph \cdot CR(OH) \cdot NC_5H_{10}$, which bear pictorial resemblance to the cinchona alkaloids, and also of two other compounds of the general formula $Ph \cdot CO \cdot CHR \cdot NC_5H_{10}$. These have been made in order to obtain information as to the group or groups responsible for the anti-malarial action of the alkaloids.

INSTITUTE OF CHEMISTRY.

At the fifty-third Annual General Meeting of the Institute of Chemistry held on March the 2nd at the Institute, Russell Square, the President, Dr. G. C. Clayton, C.B.E., presented the Meldola Medal to Dr. Reginald Patrick Linstead, of Imperial College of Science, and the Sir Edward Frankland Medal and Prize for Registered Students, to Mr. Geoffrey Broughton, of the Royal Technical College, Salford.

In submitting the Report of the Council, the President remarked on the increase in membership, which now comprises over 5,850 Fellows and Associates. The Institute encouraged those who wished to follow the profession of chemistry to take the best course possible, to become qualified, and maintained a register of competent chemists for the service of the community; but its work did not stop at registration: it rendered many services to the members and to the public. The financial position was satisfactory: the Institute was able to keep its expenditure within its income, without being unduly restricted in the pursuit of its objects. There had been an increase in the number of members without employment, which number, however, was less than 2 per cent.; but partly due to this, there had been a greater call upon the Benevolent Fund.

The Legal and Parliamentry Committee had been more than unusually active, having dealt with such matters as—chemical patents, service agreements for chemists the Dyestuffs (Import Regulation) Act, the Regulations dealing with Methylated Spirits, and a proposal to present a Petition to H.M. the King in Council for a Supplemental Charter, in order to acquire for the Fellows and Associates the right to use the title "Chartered Chemist." The Council felt that it was desirable that members of the Institute should acquire this title, in order to distinguish them from Pharmaceutical chemists.

The President also referred to the increasing activity of the seventeen Local Sections, in Great Britain and Ireland and in various parts of the Empire, and also to the lectures which had been published by the Institute during the year.

The Officers and Council for the ensuing year having been declared elected, the meeting considered the adoption of the Proposed Petition for a Supplemental Charter for the purpose indicated above, which, although on a division supported by a decided majority, was referred to a Postal Vote.

NOTICES OF BOOKS.

Torricelli contra Mundum. By Frank L. Teed, D.Sc., M.I.M.M., F.I.C. Pp. ix + 82. London: H. K. Lewis, 28 Gower Place, W.C. 1931. Price 5s.

In this stimulating little book the author explains the deduction of Gas Laws without assuming any theory as to the constitution of gases. He has based his reasoning upon the fact that a gas has a "quantity of energy" and whenever "work" was performed the gas passed from a higher to a lower pressure. The Law of the Conservation of Energy is accepted and also Torricelli's deduction from the "Law of Falling Bodies" and the author directs attention to a new method for determining *J*, the mechanical equivalent of heat.

Starting with the idea that the kinetic theory of gases is unessential for a deduction of the gas laws the author finally arrives at the conclusion that this theory is open to serious objection and he even challenges the molecular conception of matter. These views are particularly interesting at the moment since they are similar to those held by the late Prof. Frantisek Wald whose death recently has focussed attention on his attempts to establish chemical and physical laws without making any theoretical assumptions (*Chemical News*, March 13). Wald also had no faith in the atomic theory and his definitions of elements and compounds and the laws of constant and multiple proportions were as unorthodox as those expressed here. Dr. Teed points out (p. 56) that these laws were so welcome and are so capable of experimental verification that their announcement by Dalton at the beginning of last century led to their general embodiment with the Atomic Theory. If chemists are pressed for a proof of the existence of atoms they refer to the Kinetic Theory and leave the rest to the physicists. Physicists, on the other hand, declare that the chemists have shown that matter is not infinitely divisible and that, for example, a minute drop of water can be sub-divided into oxygen and hydrogen, thus indicating the atomic structure of matter!

Whatever may be thought of Dr. Teed's conclusions, his deductions of the various Gas Laws and his chapter on the mechanical equivalent of heat are valid with or without the kinetic theory and the molecular view of the constitution of matter and his refreshing views are worthy of the serious attention of all interested in the fundamental principles of chemistry.

Essentials of Organic and Biological Chemistry. By Prof. E. Wertheim, Ph.D. Pp. vi + 175. The Chemical Publishing Co., Easton, Pennsylvania, U.S.A. 1931.

This book is based upon Prof. Wertheim's course of instruction at the University of Arkansas and is an attempt at presenting the main outlines of a study of the aliphatic and aromatic compounds with a view to their general and biological significance and applications. The first eight chapters are concerned with the various homologous series of aliphatic bodies, then follow chapters on urea, the amines and optical activity and the carbohydrates before a rather brief account of the aromatic bodies.

The later chapters of the book deal with such biochemical matters as enzymes, digestion and absorption of foods, metabolism, nutrition, dietary necessities (vitamins) and foods and beverages. There is much that is new in the presentation of organic chemistry to students that the book is well worth the attention of lecturers in that subject, especially those having medical or biological audiences.

Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry, 1930, vol. xv. Pp. 758. Price 7s. 6d. (members) and 12s. 6d. post free.

The Society of Chemical Industry's Annual Reports on the year's progress in Aplied Chemistry has become an indispensable volume for all engaged in the manufacture and use of chemical products. So much is now being done in every branch of the subject that it has become quite impossible for any specialist to do more than cover the literature of the restricted field in which he is particularly concerned. Even here he has come to rely more and more on the abstracting journals and with their help and the references available in the *Annual Reports* can find out what is going on in any branch of chemical industry. As the literature increased and more journals and books are published the importance of such volumes as the Annual Reports on the Progress of Applied Chemistry becomes greater and greater.

From a perusal of the volume just issued it is evident that those concerned with its production have attempted a concise survey of the field. The sections and contributors are :—

General, Plant and Machinery by R. Edgeworth-Johnstone.
Fuel by H. J. Hodsman and A. Key.
Gas, Carbonisation, Tar and Tar Products by J. Macleod and T. A. Wilson.
Mineral Oils by Dr. A. E. Dunstan.
Colouring Matters and Dyes by L. J. Hooley.
Fibres, Textiles, Cellulose and Paper by J. C. Withers.
Acids, Alkalis and Salts by P. Parrish and F. C. Snelling.
Bleaching, Dying, Printing and Finishing by A. J. Hall.
Glass by M. Parkin.
Refractories, Ceramics and Cements by J. H. Chester and W. J. Rees.
Iron and Steel by C. O. Bannister.
Non-Ferrous Metals by A. R. Powell.
Electro-chemical and Electro-Metallurgical Industries by H. T. S. Britton and R. A. Robinson.
Oil, Fats and Waxes by H. M. Langton.
Paints, Pigments, Varnishes and Resins (by the Oil and Colour Chemists Association).
Rubber by T. L. Garner.
Leather and Glue by R. H. Marriott and H. Phillips.
Soils and Fertilisers by E. M. Crowther.
Sugars, Starches and Gums by L. Eynon and J. H. Lane.
Fermentation Industries by H. L. Hind and F. E. Day.
Foods by L. H. Lampitt.
Sanitation and Water Purification by A. Parker.
Fine Chemicals, Medicinal Substances and Essential Oils by E. Stedman.
Photographic Materials by A. Batley and E. E. Jelley.
Explosives by J. Weir.

THE OPTICAL SOCIETY.

The next meeting of the Optical Society or Session 1930-31 will be held at the mperial College of Science and Technology, mperial Institute Road, South Kensington, ;.W.7., on March 26, at 5.30 p.m. The ollowing papers will be presented and liscussed :—

"Secondary Conjugate Surfaces." By T. Smith, M.A., F.Inst.P.

" Graphical Constructions for a Refracted Ray." By T. Smith, M.A., F.Inst.P.

" Fused Bifocal Spectacle Lenses." By A. Whitwell, M.A.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Monday, March 23, at 8 p.m.—(Cantor Lecture) " Sound Recording and Reproducing Machines and their Development." By Captain A. G. D. West. (Lecture III).

Tuesday, March 24, at 4.30 p.m.—(Dominions and Colonies Meeting).

Wednesday, March 25, at 8 p.m.—(Ordinary Meeting) " The Kent Coalfields." By Professor Patrick Abercrombie, M.A., F.R.I.B.A.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Saturday, March 21, at 3 p.m.—" Alpha-Rays." By Sir Ernest Rutherford.

Tuesday, March 24, at 5.15 p.m.—"Cytological Theory of Heredity." By C. D. Darlington.

Thursday, March 26, at 5.15 p.m.—"Respiration." By F. B. S. Haldane.

Saturday, March 28, at 3 p.m.— " Alpha-Rays." By Sir Ernest Rutherford.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

BELFAST AND DISTRICT SECTION.

Tuesday, March 25, at 7.30 p.m. in the Physics Lecture Theatre of the Royal Belfast Academical Institution.—" The Absorption of Gases in Electrical discharge Tubes." By R. T. Shepherd.

PRAGUE SUMMER SCHOOL.

July 20—August 8, at the Prague Summer School, during the long vacation there will be delivered lectures in English in a number of subjects including Literature, Art and Science in Czechoslovakia, the History and Geography of Central Europe, and there will also be language courses in German, Czechoslovak and Russian.

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New Patents.

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Latest Patent Applications.

6,366.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of aminoanthraquinone nitriles. February 28.

6,169.—Union Chimique Belge Soc. Anon. —Manufacture of nitric acid. February 27.

Specifications Published.

343,449.—Loveluck, R. J., Thomson, R. F. Thomas, J., and Scottish Dyes, Ltd.—*Production of anthraquinone derivatives.*

343,530.—Pilat, S., and Sereda, J.—Production of sulphonic acids.

343,744.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of benzimidazonestibinic acids.

The Latest TRADE MARKS

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NOURISOL.

520,062.—Chemical substances used for agricultural and horticultural purposes.—Norman Platt Burgess, 46a, Purewell, Christchurch, Hampshire. March 4.

ROCKGLOSS.

519,632.—*Chemical substances used in* manufactures, photography, or philosophical research, and anti-corrosives.—Lewis Berger & Sons, Ltd., 201, Morning Lane, Homerton, London, E.9. March 4.

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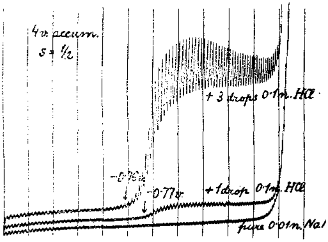
THE ELECTRO-REDUCTION OF NITRIC OXIDE AND THE ESTIMATION OF NITRATES AT THE DROPPING MERCURY CATHODE.

By J. HEYROVSKY AND V. NEJEDLY.

Neutral or alkaline solutions containing nitrites do not show, when examined polarographically, any electro-reduction at the dropping mercury cathode except that due to the electro-deposition of the alkali metal. In this respect solutions of nitrites behave like those of chlorates, perchlorates, and sulphites, in which the current-voltage curves coincide with those obtained in solutions of sulphates or halogenides. However, a slight acidulation of a nitrite solution causes *on the current-voltage curve the* appearance of a " wave " at –0.77 v. from the potential of the normal calomel electrode, the height of which increases with the amount of acid added and in excess of the acid remains constant, depending only on the amount of nitrite. Polarograms[1] 1 and 2 illustrate this behaviour.

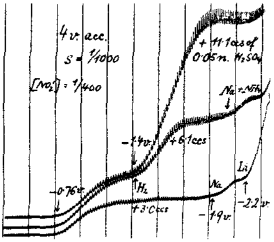


Polarogram 1.

Polarogram 1 is due to a 0.01 n. $NaNO_2$ solution from which air has been driven out by hydrogen. The lowest curve, obtained with $\frac{1}{2}$ sensitivity, shows that the solution was free from traces of electro-reducible substances. (The specimen was Merck's " pro analysi "). Next, to 20 ccs of this nitrite solution one drop of 0.1 n. HCl has been added (all in the atmosphere of hydrogen) so that the concentration of hydrions was about 1/4000 n.

[1] Obtained with the apparatus " Polarograph," registering current-voltage curves. Type VI driven by motor, has been used, constructed by Dr. V. Nejedly, Prague—XIX, Husova No. 76, Czechoslovakia.

The increase of current at the cathodic potential of −0.77 v. indicates a new electro-reduction which cannot be due to evolution of hydrogen, since this would occur, considering the present concentration of hydrions, at −1.4 v. The evolution of hydrogen does not take place until we add to the solution an excess of hydrions to be at least 5 times more concentrated than the nitrite (the concentration being expressed in gram-molecules). This is shown



Polarogram 2.

in polarogram 2. Here 0.05 n. H_2SO_4 has been added from a burette to 20 ccs of 0.00025 m. $NaNO_2$ solution in 0.1 n. Li_2SO_4. When 3.0 ccs were added, the curve showed only the "wave" at −0.76 v. besides one at −1.9 v. evidently due to to the deposition of sodium; the increase of current at −2. 2 v. is caused by the deposition of lithium. However, after an addition of 6.1 ccs of the acid the "wave" at −0.76 v. reaches its maximal height and the evolution of hydrogen is distinctly observable from the "wave" at the potential of about −1.4 c. Further additions of the acid increase merely the "hydrogen wave" at −1.4 v., the "nitrite wave" at −0.76 decreasing slightly owing to the dilution of the solution when 11 ccs of the acid were added.

This behaviour resembles closely that observed in the electro-reduction of sulphites in the presence of acids[2] and becomes at once obvious when explained in the same manner. The acid liberates in the nitrite solution free unionised nitrous acid, which decomposes according to the known equations:

$$3NaNO_2+3HCl \longrightarrow 3NHO_2+3NaCl$$
$$3HNO_2 \longrightarrow 2NO+HNO_3+H_2O \quad \ldots \quad (1)$$

[2] B. Gosman: *Collection of Czechoslovak Chemical Communications*, **1930, II, 185.**

Neither the nitrite nor the nitrite anion is reducible at cathodic potentials less negative than −1.6 c., consequently the "wave" at −0.76 v. must be due to the reduction of the liberated nitric oxide. That this is really so has been shown by the following experiments:

1. Prolonged bubbling of hydrogen through an acidulated solution of nitrite causes a decrease of the "wave" at −0.76 v. and, finally, after passing hydrogen for ca. 12 hours, its complete disappearance.

2. An alkaline solution, through which hydrogen was bubbled after passing first through the acidic nitrite solution, shows after acidulation again the "nitrite wave" on the current voltage curve.

3. Pure nitrogen peroxide (prepared by heating lead nitrate) added to an acidic solution causes the appearance of the same "wave" at −0.76 as observed in acidified nitrites.

The latter reaction is, of course:

$$2NO_2+H_2O \longrightarrow HNO_2+HNO_3 \quad \text{and again}$$
$$3HNO_2 \longrightarrow 2NO+HNO_3+H_2O.$$

The absence of the "hydrogen wave" in weakly acidified nitrite solutions is, no doubt, due to the process of electro-reduction of nitric oxide, which proceeds at the expense of hydrions. Molecules of nitric oxide are incapable of direct electro-reduction and can only be reduced by hydrogen atoms in "nascent state." This happens at the potential −0.76 to −0.77 v., where NO acts as a depolariser. The process is thus not a primary reversible electro-reduction but a secondary reduction by means of the deposited atomic hydrogen.

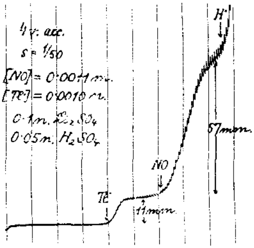
The products of this reduction might be manifold:

$NO+H \longrightarrow \frac{1}{2}N_2O.H_2O$ (hyponitrous acid)
$NO+2H \longrightarrow \frac{1}{2}N_2+H_2O$ (nitrogen)
$NO+3H \longrightarrow NH_2.OH$ (hydroxylamine)
$NO+4H \longrightarrow \frac{1}{2}NH_2.NH_2+H_2O$ (hydrazine)
$NO+5H \longrightarrow NH_3+H_2O$ (ammonia)

The first reduction process proceeds thus at the expense of the hydrions and consequently the "hydrogen wave" does not appear on the curve until full number of hydrions, requisite for the reduction of each molecule of NO is reached.

We can obtain this number from the concentration of hydrions necessary to effect the appearance of the "hydrogen wave" on the polarographic curve as shown in the polarogram 2. Here when 3 ccs were added to 20 ccs of the nitrite solution the initial concentration of hydrions was 0.0065 n.;

yet the reaction with the 0.0025 m. nitrite caused — according to (1) — a loss of $\frac{1}{3}$. 0.0025 gr-eq. of hydrions. The resulting concentration of hydrions, *i.e.*, 0.0049 n., does not, evidently, suffice for a complete reduction of the nitric oxide which is present in a concentration $= \frac{2}{3}$.0.0025 m.—0.0016 gram-molecules NO per litre. However, when 6.1 ccs of the acid are added, the following figures are obtained : concentration of hydrions = 0.010 n., concentration of nitric oxide = 0.0013 m., *i.e.*, there are more than 7 hydrions for each molecule of nitric oxide when free hydrions begin to be deposited at the deposition potential of hydrogen (−1.4 v.). Closer observations of this excess amount give 6 or 5 hydrions for one NO.



Polarogram 3.

Thus the probable number of hydrogen atoms which reduce a molecule of nitric oxide is five. Hence the electrode process is :

$$5\ominus + 5H^{\cdot} \longrightarrow 5H$$
$$NO + 5H \longrightarrow H_2O + NH_3.$$

The process of reduction of 1 mol of NO requires thus 5 faradays of electricity. That this is so is shown from the comparison of the saturation currents (" waves ") on a curve due to a solution containing an equal number of monovalent reducible cations, Tl, as well as molecules of NO.

Polarogram 3 gives an example of this investigation. The solution electrolysed contained 0.0011 mols NO and 0.0010 gr-ions Tl^+ per litre. The saturation currents are known to depend—at the same rate of *dropping of mercury*—*on the diffusion* velocity of the reducible particles and on the number of faradays they consume per gram-particle. Since the volumes of NO and Tl^+ are practically equal, their rate of diffusion may be regarded as identical, and hence the heights of the saturation currents (" waves ") should be in the ratio of faradays consumed per gram-particle. This ratio is almost exactly equal 1 : 5, indicating again that when 1 ion of Tl^+ requires one negative charge to be deposited, one molecule of NO requires five charges to be reduced, *i.e.*, five atoms of hydrogen to yield ammonia.

In the acidic solution ammonia forms instantly with the present acid the ammonium salt, which again should be electrodeposited at its reduction potential.

The " deposition potential " of ammonia, at −1.76 v. is close to that of sodium, at −1.84 v. Therefore a "wave " should appear on the polarographic curve of solutions containing nitric oxide, which would show simultaneous electrodeposition of ammonium and sodium at ca. −1.8 c. (when maximal sensitivity is applied).

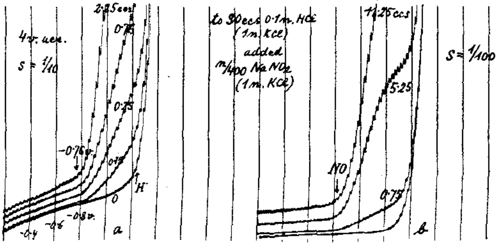
Indeed the dimension of the " wave " at −1.9 v. (see polarogram 2.) seems to indicate that this really happens. At the concentration 0.0013 m. of the nitric oxide the concentration of sodium ions must be—according (1)—$^3/_2 \times 0.0013 = 0.0020$ n., the concentration of ammonia formed by reduction, being equal to that of nitric oxide, is 0.0013 n. If no ammonium were deposited, the saturation currents due to NO and Na should be in the ratio $5 \times 0.0013 : 0.0020 = 65.20$; with the formation of ammonia, in the ratio 65 : 33. The observed ratio is $22 : 10 = 66 : 30$ which is decidedly nearer to the ratio expected when the final reduction product is ammonia.

The solutions used in these investigations were checked by titration, the nitrites by permanganate and the acids by standard baryta.

Next, *the shifts of the reduction potential* of nitric oxide were determined by increasing the amount of nitrite in a fairly acidic solution (0.1 n. HCl) and, on the other hand by increasing the concentration of hydrions in a solution with a constant amount of nitrite. These investigations have shown that a ten-fold increase of the concentration of hydrions causes the reduction potential to be more positive by ca 50 millivolts. However, the shifts due to the increase of the nitrite content were small and indistinct (*see* polarogram 4.a).

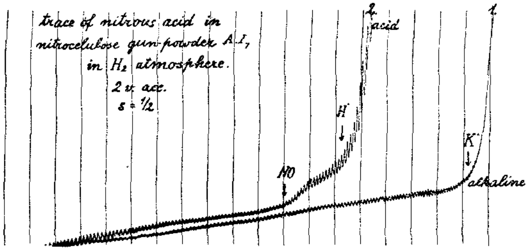
Polarogram 4.a) also shows that nitrites might be quantitatively estimated in small traces judging from the height of the " wave " they cause in a fairly acidic solution. Already an addition of 0.15 cc. of 0.0025 n. $NaNO_2$ added to 80 ccs of 0.1 n.

HCl (*i.e.* 1.2×10^{-5}n. $NaNO_2$) produces an effect on the curve distinctly visible when $^1/_{10}$ of the possible sensitivity of the galvanometer is applied. The height of the "nitrite wave" is proportional to the amount of nitrite present (see polarogram 4.b).



Polarogram 4.

This induced the present authors to attempt to estimate traces of nitrous acid or nitrites in explosives, where such impurities are supposed to cause instability.



Polarogram 5.

For this purpose ca. 1 gram of pure nitrocellulose or gun-powder was suspended in 100 ccs. of a ca. 0.1 n. alkali hydroxide solution and some part of it introduced into the electrolysing vessel. Hydrogen was then passed through the solution for several hours and after all air has been expelled, the solution electrolysed with the usual polarographic arrangement. Thus curve 1. (polarogram 5) has been obtained. Next, this solution was acidified by pouring in it —in the atmosphere of hydrogen—an excess of acid. Curve 2. was then obtained, which shows a distinct "nitrite wave" due to the reduction of the liberated nitric oxide. Prolonged bubbling of hydrogen has removed this "wave," so that only the bend due to the evolution of hydrogen remained on the curve. Control experiments carried out to test the purity of the reagents used, gave always a negative result, all acidic solutions being free from the "nitrite wave."

Gun-powders were also tried, which contained nitroglycerin; their alkaline suspension could not have been, however, tested directly for the presence of nitrous acid in this way, since nitroglycerin itself is easily reducible at the dropping mercury cathode. Thus an acidified suspension was prepared and hydrogen, passed through this solution, was allowed to pass through an alkaline solution, where the nitric oxide, liberated in the first solution, was absorbed. After all air has been expelled from both solutions, the alkaline one was acidified and the content of the nitric oxide determined by the height of the "nitrite wave."

However, it could not have been yet ascertained how much of the nitrous impurities, contained in the explosives, can be in this manner extracted; this has been left for another special quantitative investigation.

SUMMARY.

Neutral or alkaline aqueous solutions of nitrites are not reduced electrolytically at the dropping mercury cathode. However, when acidified solutions containing nitrites are examined polarographically an increase of current takes place at the potential −0.77 v. from that of the normal calomel electrode.

The saturation current increases with the amount of the acid added and remains constant if the excess of the acids is at least five times as great as the amount of nitrite. In excess of acid the saturation current is proportional to the concentration of the nitrite. Thus traces of nitrites of the order 10^{-5} n. *i.e.*, 1 part per 1,000,000, can be revealed and estimated.

The substance reduced at −0.77 v. is nitric oxide, liberated by the acid. The electro-reduction is a secondary one, nitric oxide being reduced to ammonia by primarily deposited hydrogen atoms, so that one mol NO takes up 5 faradays.

Practical applications are given in which nitrous acid is traced in nitrocellulose and gunpowder.

The Physico-chemical Institute,
Charles University,
Prague.

—(From *Collection of Czechoslovak Chemical Communications*, 1931.)

TENDER FOR DYES AND BLEACHES FOR EGYPT.

The Commercial Secretary to The Residency, Egypt, reports that the Gharbia Provincial Council, Tanta, is calling for tenders to be presented in Egypt by the 2 May, 1931, for the supply of various dyeing and bleaching materials.

Firms desirous of offering materials of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number F.X. 1062 should be quoted.

ELECTROLYTIC PRODUCTION OF HYDROGEN AND HYDROXIDES.

By R. SAXON, B.Sc., F.C.S.
Mem. Soc. Chem. Ind.,
Mem. Amer. Chem. Soc.

MANGANESE.

This metal is in the middle of the "intrusive stratum" comprising Vanadium, Chomium, Manganese, Iron, Cobalt, Nickel and Copper, weakly basic at the latter end, and weakly acid at the vanadium end. It is an amphoteric series decidely grading itself by increasing atomic weight, alongside lessening affinity for oxygen. Manganese shows more than any of the others a dual role of base or acid. It decomposes water like the alkalies but slowly giving white hydroxide thus,

$$Mn + 2HOH = Mn(OH)_2 + H_2,$$

or more concisely,

$$Mn / 2HOH = Mn(OH)_2 / 2H.$$

Using a current voltage of 240 through water with an anode of manganese, a cathode of any metal that is handy, under a boiling tube to collect the cathode gas, there forms immediately streaming from the anode a beautifully crimson purple veil that as it wraithes away from the anode disappears. The ruby stream becomes warm brown owing to contact with hydrogen as a septum of colloid or biscuit clay will assist its permanence as probably $Mn(OH)_4$ the hydrated dioxide.

Hydrogen is given off copiously and rapidly from the cathode and collects in the cathode tube. A copious crop of hydrated brown manganic oxide collects everywhere in the liquid decreasing in redness as it gets away from the anode to form a rich chocolate brown finally. As in the case of iron we seen the tendency to set off with the highest oxides to let these suffer reduction, *but not below the sesquioxide* Mn_2O_3. There is evidence of the monoxide MnO, or its hydroxide the white $Mn(OH)_2$. We can take this brown hydrated oxide and leave in contact with potash, soda or lime, or warm with these. In every case we get the green manganate K_2MnO_4.

Manganese is a solitary metal in its series, very much like aluminium, which has no common congener like sodium with potassium, magnesium, zinc, and cadmium, strontium, and barium, etc., and shows that vigorous displacement of hydrogen from water under electrolysis, which makes it foreign to the seventh group. It is attacked by acids more vigorously than zinc though slightly denser. Electrolysis of a

strong solution of sodium nitrate makes no apparent difference to the yield of brown oxide, except that the action is quicker than with water but not greatly so. It would appear that what are termed strong oxidizing agents are not more strong than water under the action of electrolysis.

The electrolysis of a solution of a permanganate, or the acid will give the same brown hydroxide using the manganese anode, as with water, whether or not oxidising agents be present. It appears from these experiments that under the influence of electrolysis the stable final form of the oxide is the sesquioxide. Iron forms this first but this is reduced to the ferrous hydroxide later, cobalt forms the rose red $C.(OH)_2$, nickel the green $Ni(OH)_2$, and copper the blue $Cu(OH)_2$, next the white CuOH, and then the metal. Thus do we see a falling off in affinity from the manganese to the copper as far as oxygen is concerned.

PREPARATION OF O-CHLOROTOLUENE FROM P-TOLUENE SULFONCHLORIDE.

By L. McMaster and J. Carol.
(Chemistry Department, Washington University, St. Louis, Mo.)

The *p* toluene sulfonchloride used in this work was supplied by the Monsanto Chemical Works. It was melted and mixed with a small quantity of antimony trichloride. This mixture was warmed to about 70° C. and dry chlorine passed into it slowly, with stirring, until there was an increase in weight corresponding to 1 mol of chlorine for 1 mol of *p*-toluene sulfonchloride. Allowance was made for the amount of chlorine used to change the antimony trichloride to pentachloride. The temperature in all but one run, was maintained at 70-80° C. to prevent the formation of higher chlorinated derivatives. At 120° C. such derivatives begin to be formed. About 3 hours were required to chlorinate the mixture, after which it was poured into ice water, whereupon *o*-chlor-*p*-toluene sulfonchloride separated as a solid. It melted at 37-37° C., after crystalization from petrolenm ether.

The *o*-chloro-*p*-toluene sufonchloride was washed several times with dilute caustic soda solution, which was poured off with the suspended antimony oxychloride. It was then washed with water, dissolved in ether, and dried over calcium chloride. After the ether was evaporated, the product was obtained as crystals of melting point 37° C. The amide obtained from it melted at 137.5° C.

The best conditions for the prepartion of *o*-chloro-*p*-toluene sufonchloride by chlorinating *p*-toluene sulfonchloride are for each 190.5 grams (1 mol) of the *p*-toluene sulfonchloride, 4 grams of antimony trichloride should be added and the mixture chlorinted at 70-80° C. with constand stirring. slightly higher temperatures may be used.

An attempt was made to replace the antimony trichloride by powdered iron. One mol *p*-toluene sulfonchloride was melted, 0.5 gram of powdered iron added, and the mixture chlorinated. It was continued until an increase in weight of 38 grams occurred. The chlorinated mixture was poured into a mixture of ice and diluted hydrochloric acid and washed free from iron chloride. The mixture would not solidify, but remained as a thick paste. It is quite probable that a mixture of chlorinated products was obtained, as no *o*-chlorotoluene was obtained from it.

o-Chlorotoluene from *o*-Chloro-*p*-Toluene Sulfonchloride.

One mol (225) grams of the *o*-chloro-*p*-toluene sulfonchloride was mixed with 500 grams of 80 per cent. sulfuric acid and distilled with steam. The *o*-chloro-*p*-toluene snlfonchloride distilled over unchanged. Sulfuric acid solutions of various concentrations were tried—10, 40, 50, and 60 per cent. With only the 50 per cent. solution was a small amount of *o*-chlortoluene obtained.

An attempt was made to split off the sulfonchloride group by water under pressure. One-tenth mol (22.5 grams) of the material was mixed with 50 cc. of water, sealed in a glass tube, and heated in an antoclave for 5 hours at 200° C. The *o*-chloro-*p*-toluene sulfonchloride was not changed to *o*-chlorotoluene. but to *o*-chloro-*p*-toluene sulfonic acid. This solution was made up to an 80 per cent. sulfuric acid concentration and distilled with superheated steam. A 90 per cent. yield of *o*-chlorotoluene was obtained.

It was found that the *o*-chloro-*p*-toluene sulfonchloride could be changed to the correspondiug sulfonic acid by refluxing it with water and sulfuric acid. Sulfuric acid concentrations of 10,50, and 85 per cent. were used, but the hydrolysis was found to take place most rapidly in the 10 per cent. solution. When this solution was made up

to an acid concentration of approximately 80 per cent. sulfuric acid and distilled with superheated steam, *o*-chlorotoluene was obtained. It was thus shown that it is first necessary, with the *o*-chloro-*p*-toluene sulfonchloride, to hydrolize the sulfonchloride group to the sulfoxyl group by means of dilute sulfuric acid and then to split off the latter group by concentrated sulfuric acid and distillation with superheated steam in order to obtain favourable yields of *o*-chlorotoluene. Concentrations of sulfuric acid above 85 per cent. produce carbonization.

It is not necessary to purify or dry the crude *o*-chloro-*p*-toluene sulfonchloride. In order to ascertain the over-all yield of the process, 381 grams (2 mols) of *p*-toluene sulfonchloride were chlorinated, using 10 grams of antimony trichloride as a catalyst and a temperature of 70-80° C., until an increase in weight of 75 grams was obtained. The product was washed several times with water, drained, and then refluxed with 400 cc. of 10 per cent. sulfuric acid until complete solution was obtained. This solution was then made up to an 80 per cent. sulfuric acid concentration and distilled with superheated steam. The *o*-chlorotoluene which distilled over was separated from the water, washed with caustic soda solution, washed again with water, and dried over calcium chloride. The purified *o*-chlorotoluene distilled at 157-159° C.

(*Abstracted from Industrial and Engineering Chemistry, February*, 1931.)

RUHR CHEMICAL CORPORATION BONDS REDEEMED.

The redemption of $105,000 (say £21,000) principal amount of 6 per cent. Sinking Fund Mortgage Bonds, Series A, of the Ruhr Chemical Corporation, is announced by Dillon Read and Company, of New York, as fiscal agents. The bonds designated for redemption are payable on April 1 at 100 and interest in New York at the office of Dillon Read and Company; or at the option of holders, in London at the office of M. Samuel and Company, Ltd., in sterling; in Amsterdam at the office of Mendelssohn and Company guilders; or in Zurich at the office of the Credit Suisse in Swiss francs.

The bonds are part of an issue of $4,000,000 (say £800,000) 20-year 6 per cent. bonds made for the Ruhr Chemical Corporation by Dillon Read and Company, in 1928.

LORD RUTHERFORD ON THE ALPHA RAYS.

Lord Rutherford gave an address at the Royal Institution on Saturday, March 7, on "Recent Researches on the Alpha Rays." He said the most typical mode of disintegration of radium and other radioactive bodies consisted in the expulsion of an α particle, or helium nucleus, from the radioactive nucleus with great velocity and energy. In recent years a number of researches had been made to test whether the liberated α particles all possessed the same speed or whether they consisted of groups of α particles characterized by small differences in velocity. The complexity of the α rays had been analysed by deflecting them in a powerful magnetic field, and in many cases it had been fonnd that the α particles appeared to be homogeneous in velocity with an accuracy of about one part in a thousand. On modern views, this indicated that the α particle in the nucleus before expulsion occupied a certain definite energy level which was defined by quantum conditions. It seemed, however, not unlikely that other energy levels might also exist within the nucleus and that some of the α particles might be liberated with a different speed. If such groups of α particles could be detected, we had a method of determining the levels with the nucleus.

With the ordinary electro-magnets available in the laboratory the α particles could suffer only a small deflection, but a great improvement in the resolution of any complexity would be produced if the α particles could be bent round a semi-circle, when a definite focusing effect could be produced. This had recently been accomplished by Rosenblum using the gigantic electro-magnet in Paris designed by Professor Cotton. The pole-pieces of this electro-magnet were about one metre in diameter, and a small power station was required to excite the electro-magnet. In this way a strong magnetic field could be produced over a large area, and it was possible to bend the α particles into a semi-circle of radius about 20 cms. By use of the focusing method it was found that the α particles from a number of radioactive bodies appeared to be homogeneous to a high degree, but in one element, thorium C, the α particles were shown to consist of a number of distinct groups each characterized by a definite speed. In subsequent lectures, concluded Lord Rutherford, other powerful methods for examining the complexity of the α rays would be described and illustrated.

GENERAL NOTES

FOREIGN COMPETITION AND THE DYESTUFFS TRADE.

Mr. L. P. Rendell on March 18 before the Guild of Calico Printers and Dyers Foremen, at Glasgow, described how Great Britain, who before the War imported *practically the whole of her requirements* in dyestuffs, has become largely self-supporting and is increasing her exports, which already almost equal her home consumption.

Competition in dyestuffs only developed after the War, when countries not previously having a dyestuffs industry began to manufacture on a considerable scale. Germany is still the largest producer, although her output is only about half what *it was in 1913. After her come the U.S.A.*, Great Britain, France, Switzerland and Italy, Switzerland having sunk from second to fifth place. Immediately after the War prices were high and quality low in all countries, but it was noticeable that as the British industry expanded there was an immediate and considerable drop in the prices of those products manufactured here. The first real fall in the price of any product coincided with its being placed on *the market by British manufacturers. The* quality of the German product improved at the same time, so that British dyestuffs users benefited in both directions.

The post-war weakness of foreign competitors and the boom in the textile trade enabled the British industry to survive the year of unrestricted imports following the Sankey Judgment, to be saved just in time by the passing of the Dyestuffs Import Regulations Act in 1920.

THE DYESTUFFS ACT.

The question of the Act is so bound up with the whole question of foregin competition, that it is impossible to avoid constant reference to it. If it had not been passed the United Kingdom would have been entirely dependent on Germany for dyestuffs, but it is the opinion of many that if it had lapsed last January, we should have been faced with more dumping from the U.S.A., than from Germany, who actually only supplies 75 per cent. of her home market. The fear that the Act would only serve to bolster up inefficiency has proved vain, in fact the British Manufacturer has rather been hard-pressed by the Licensing Committee's grantings of licenses to import a dyestuff on account of some negligible difference between the foreign product, and our own, while often the real reason for the application was the difference in price. The manufacturer has suffered from observance of the letter rather than the spirit of an Act designed for his protection. One new condition, under which the Licensing Committee propose to grant or with-hold licenses is that the price in this country must be no greater than the foreign price, which will necessitate safeguards to prevent foreign dyestuffs being offered here below the price in *the country of origin.*

There have been many instances of developments directly due to the Act, such as the extension of the range of Acid Anthraquinone Blues. Whereas before the War there were only three or four types, there are now nearly a dozen in general use and no limits to possible variations. The German lead has forced British research chemists to concentrate on working out processes for the manufacture of dyestuffs already established by foreign makers, rather than on original research. Nevertheless, some outstanding work has been done, the whole range of dispersed colours for acetate silk having sprung from a British invention and also Caledon Jade Green, the fastest dye in the World.

INTENSE COMPETITION.

The dyestuff trade of to-day is exceedingly complicated and difficult to follow. For the manufacturer it is only possible to keep in touch by constant examination of competitive samples and a very complete filing system to tabulate the results. There are hundreds of different dyestuffs in common use, most of them manufactured in this country under different trade names by at least four or five different makers. Intensive competition has induced a readiness on the part of colour manufacturers to give technical advice and service on any problem which arises, however remotely connected with dyeing, involving the employment of a large number of colourists. Additional work is also entailed by varying conditions in overseas markets.

For example, in the Bazaar trade in the Near East great stress is laid on the importance of physical appearance, even more than on the strength of tone or shade produced. This is probably due to German insistence on appearance in the first instance. Packing and an attractive and distinctive label are also important.

It is evident that Japan will have to be reckoned with in world markets in future, and intensified competition is giving a fresh impetus to research.

In some ten years or so dyeing methods will have been completely revolutionised. The dyers of the future will be fully-fledged chemists. With goodwill and co-operation from dyestuff users ,there is not much doubt that the industry in this country will continue to forge ahead to the mutual benefit of users and manufacturers.

FERTILISER FOR CANADIAN WHEAT LANDS.

Experiments have recently been conducted by the Provincial Departments of Agriculture of Manitoba, Saskatchewan and Alberta in connection with the use of phosphatic fertilisers in the cultivation of grain crops. The experiments in question were conducted by the authorities named in conjunction with the Dominion Experimental Farms, the Canadian Pacific Railway Company and the Consolidated Mining and Smelting Company of Canada, Ltd.

The great fertiliser plant of the Consolidated Mining and Smelting Company at Trail, B.C., is now nearing completion, and will be able to supply chemical fertilisers to farmers on the Canadian Prairies some time in Spring.

During the past three years extensive trials with both ammoniumpbosphate and triple super-phosphate have been conducted on hundreds of farms in the Prairie Provinces. In Manitoba high grade triple super-phosphate and ammonium-phosphate drilled in at the time of seeding increased yields of wheat by from 18 to 50 per cent. as compared with untreated crops in the same localities, and produced corresponding increases with other grain.

In Saskatchewan it was found that the use of fertilisers tended to produce more even crops, as it neutralised soil variation. Earlier maturity, another characteristic of the fertilised crops, will be extremely valuable in the northern areas of the arable section of the Province, as well as in the neighbourhoods where grain is normally liable to rust and frost, and where early maturity will, therefore, materially reduce loss. Advances of as much as twelve days in the time of ripening have been recorded, while in the majority of tests the improvement in this respect varied between five and ten days. Increased yields on fertilised lands have been fifteen bushels per acre more than on unfertilised fields, the grain being higher in some cases. Increases of seven bushels per acre have been numerous, and only a comparatively small proportion of the tests failed to show any increase.

CANADIAN MEDICINAL AND PHARMACEUTICAL PREPARATIONS PRODUCTIONS.

The Dominion Bureau of Statistics, in a Report on the Canadian Medicinal and Pharmaceutical Preparations Industry in 1929, states that the 140 plants producing patent and proprietary medicines, pharmaceutical chemicals and similar commodities, had a total production during the year valued at $19,038,894. This total reperesent a new record for the industry, 11 per cent. in excess of the 1928 total and 17 per cent. better than the output for 1927.

Of the manufacturing plants, 80 were located in Ontario, 45 in Quebec, 5 in Manitoba, 4 in British Columbia, 3 in Nova Scotia, 2 in New Brunswick and 1 in Alberta. They had a total capitalisation of $19,552,949 and employed 2,849 persons, utilising materials valued at $6,300,894.

Of the products turned out during the year, patent medicines and proprietary preparations had a total value of $7,807,791, and pharmaceutical preparations represented a total value of 6,578,494. Other products included toilet preparations worth $2,110,718, as well as flavouring extracts, biological preparations, confecttionery, soaps, dental supplies, disinfectants, etc.

SWEDEN.

Memorandum on the Appointment of Agents, Terms and Methods of Payment, Etc.

A confidential memorandum containing information regarding the appointment of agents, and terms and methods of payment in Sweden, together with some general notes on the market, prepared by the Commercial Counsellor, His Majesty's Legation, Stockholm, has been issued by the Department of Overseas Trade to firms whose names are on its Special Register. British firms who desire to obtain a copy of the memorandum and particulars of the Special Register service should apply to the Department (Reference number C.X. 3473 should be quoted).

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

March 12, 1931.

The following papers were read :-

On the Reaction of the Dental Pulp to Peripheral Injury of the Dentine. E. W. FISH. Communicated by C. Lovatt Evans, F.R.S.

A series of earlier experiments in which diffusible dyes were placed in the pulps of human teeth indicated that when primary dentine is injured at the periphery either by caries or attrition the whole tract of affected tubules dies and becomes walled off from the pulp by secondary dentine.

The experiments upon which this report is based were carried out to investigate the nature of this reaction and consisted in grinding a shallow cavity in the surface of the dentine and cutting serial sections of the teeth 2, 4, 8, 12 and 16 weeks later.

The nature of the reaction varied with the severity of the lesion. The usual result was that the pulp ends of the injured tubules were sealed off by a deposit of calcium salts, and this was followed by a deposit of secondary dentine.

The secondary dentine coincided exactly with the extent of the lesion, the injured tubules only being covered by it.

The odontoblasts associated with the injured tubules undergo degeneration and most of them die, a proportion survive showing regenerative changes and lay down the tubules in the secondary dentine.

When, as sometimes happens, all the odontoblasts die under the affected tubules hyaline secondary dentine is formed and large connective tissue cells with single nucleoli are found at the edge of the forming secondary dentine.

A frequent result of cutting an experimental cavity in normal dentine is the production of small hæmorrhages in the general pulp tissue, which persist for some months, showing only a slight round cell infiltration.

The Combination Curves, Hydrogen Ion regulating Power and Dissociation Constants of Gelatin. E. B. R. PRIDEAUX. Communicated by F. S. Kipping, F.R.S.

The properties of gelatin as an ampholyte have been deduced from the combination curves in which p_H is expressed as a function of added acid or alkali.

The hydrion regulating power is low in relation to the weight of dry gelatin, and is deduced by means of the "buffer" equation at p_H values near to the isoelectric point. This equation, and other methods, lead to values of the equivalents as acid or as base which are in good agreement among themselves, being about 1200 to 1600, according to the part of the curve investigated.

In solutions containing 0.1 per cent. of gelatin (alkaline range) the buffering power (per 1 g.) is higher and the combining weight is lower. The ratio between the acidic and basic constants so calculated agrees well with that calculated from the nature and amounts of the fission products.

Considerable differences were noted between the combination curve of gelatin, and those of amino acids. By means of equations which express the simultaneous relations : (*a*) absence of inflection at the isoelectric point, (*b*) the existence of the isoelectric condition; the constants of the basic and acidic dissociations have been calculated on the assumptions that gelatin consists mainly (i) of undissociated molecules, (*ii*) of amphoric ions at its isoelectric point. On either theory, three constants are obtained, of which one acidic and one basic constant are nearly equal to one another.

Experiments on Growth and Inhibition. By R. SNOW. Communicated by A. G. Tansley, F.R.S.

Since it has been found previously ("*New. Phyt.*," vol 28, p.345, 1929) that in older and taller pea seedlings, the young leaves near the apex inhibit the axillary buds near the base of the stem more strongly than in very young short seedlings, experiments were carried out to test whether the increase in strength of inhibition is due to the greater length of intervening stem. It was found that in etiolated pea seedlings, single developing leaves or apical buds, whose inhibiting effect has been weakened by removal of their outer leaves, inhibit axillary buds at considerable distances below them (from 70 to 170 mm.) more strongly than similar leaves or apical buds in similar seedlings inhibit those that are at much smaller distances below them (from 5 to 42 mm.). Also the effect of single developing leaves on two axillary buds at different distances below them in the same shoot, is that while they retard the outgrowth of both buds,

they retard the more distant one more strongly. It is concluded that the strength of inhibition increases with increasing length of intervening stem.

It is pointed out that axillary buds normally grow to a certain length before they are stopped by inhibition, and it is shown that none-the-less they are susceptible to inhibition during their early growth as well as later. For when extirpated, they are rapidly formed again in decapitated seedlings, but not in intact seedlings. It is concluded that normally they are at first not inhibited because they are too close to the developing leaves. They therefore grow until, through the growth of the main shoot, they reach a distance below these leaves at which inhibition is strong enough to stop them. The interpretation of the increase of inhibition is briefly discussed.

The following papers were read in title only :—

The Effect of Light on the Oxidation of Fats. By C. H. LEA. Communicated by Sir William Hardy, F.R.S.

A quantitative iodimetric method for estimation of the peroxide oxygen present in rancid fats is described. By this means it is possible to follow the atmospheric oxidation of pure fats or of animal fats in the tissue, and, in conjunction with a suitable source of light, to forecast the relative susceptibilities of fats to oxidation. This method, together with a quantitative modification of the Kreis test, has been used to investigate the effect of light on the oxidation of fats.

A Spectrographic Analysis of Animal Tissues. By H. MUNRO FOX AND H. RAMAGE. Communicated by J. S. Gardiner, F.R.S.

A quantitative spectrographic method has been used for the analysis of some of the less common elements contained in animal protoplasm and secretions. Tissues of annelids, molluscs, man, and some other animals have been studied. Iron and copper were present in all kinds of protoplasm investigated. Manganese was widely distributed. The manganese content of tissues varies with the locality in which a given species of animal lives. Nickel and cobalt occurred spasmodically, the former being more frequent. Except in one case, all high concentrations of nickel were accompanied by cobalt. In one tissue only did cobalt occur without detectable nickel. Lead and silver both exhibit an irregular distribution. Certain tissues have a disposition to accumulate one or other of these elements. One man had silver in all organs, two others had none. Lead accumulates in different tissues of different individual men. Cadmium occurred in the livers of *Pecten maximus* from several different situations. Lithium is very widespread in animal tissues, rubidium is much less so, while cæsium was not found. Strontium was found in numerous cases. Barium was absent. Calcium fluoride was found in one case only, namely, the body wall of *Archidoris tuberculata.*

The Reproductive Processes of certain Mammals, I. By A. S. PARKES. Communicated by C. Lovatt Evans, F.R.S.

The animals failed to breed under laboratory conditions, but it was found possible to investigate the cyclic changes occurring in the non-pregnant females, about half of which possessed perfectly normal reproductive organs. The cycle is very similar to that of the mouse. Cornification of the vaginal epithelium, diagnosed in the live animal by examination of the vaginal contents, was found to be associated with the period of ovulation. The average length of cycle was a little under five days, and the average number of follicles maturing at one period of ovulation was eight. Other specimens of *Cricetulus* (in the possession of Professor J. P. Hill), which had been collected in the field, showed a number of extraordinary structures in the uterine wall. These bodies are obviously glandular in nature and would appear to be true myometrial glands. Since they were found in the laboratory specimens, they would seem to develop during some phase of the fertile cycle.

The Delayed Lethal Effect of Radium on Tissue Cultures in vitro—Comparison of Continuous and Spaced Radiation. By F. G. SPEAR. Communicated by Sir Frederick Andrewes, F.R.S.

Experiments were made with tissue cultures in vitro to compare the length of the survival period after exposure to a continuous radiation known to be lethal, with the survival period following exposure to a spaced radiation of the same intensity and total duration. It was found to be immaterial whether the radiation was given in one dose of six six hours or in six fractional doses of 60 minutes each at 24 hourly intervals.

THE PHYSICAL SOCIETY.

February 20, 1931.

The following papers were read :—

On the Velocity of Sound Waves in a Tube. By G. G. Sherratt, B.A., and J. H. Awberry, B.A., B.Sc., F.Inst.P., Physics Department, National Physical Laboratory, Teddington, Middlesex.

The apparent velocity of sound in a tube of diameter 2 cm. has been measured at temperatures up to 400° C. and with frequencies of from 3000 to 14000—. The reduction in velocity below the free-air value is discussed, and the suggestion is put forward that this reduction, for a single tube and gas, depends on the wave-length rather than on the frequency. The theoretical expression found by Helmholtz and Kirchhoff for the reduction in velocity does not appear to be valid, at any rate for the conditions obtaining in these experiments. The method nsed by Dixon and by Partington and Shilling for correcting for the influence of the tube receives support from the present results. The experiments reveal the complication which ensues when the wave-length fails below a certain multiple of the tube-chamber.

The Tube Effect in Sound-Velocity Measurements. By P. S. H. Henry, Coutts Trotter Student, the Laboratory of Physical Chemistry, Cambridge.

The modifications in Kirchhoff's formula required to take account of the finite thermal conductivity of the tube, slip between the gas and the walls, temperature-discontinuity between gas and the walls, and absorption of energy by the walls, are calculated and found to be negligible. The effect of roughness of the walls is discussed, and the conclusion is drawn that the large tube-effects often found in practice are due to irregular motion of the gas. It is argued that the methods of correcting for the tube-effect used hitherto are unreliable. The effects of oscillation of the piston and of the gas behind the piston are investigated and it is shown that these may become appreciable in some forms of apparatus. The yielding of a tube of elliptical cross-section is calculated, and is shown to have a negligible effect.

A Note on the Elimination of the β wave-length from the Characteristic Radiation of Iron By W. A. Wood, M.Sc., Physics Department, National Physical Laboratory.

A practical method of eliminating the β wave-length from the characteristic radiation of iron is described. The method is based upon the selective absorption produced by a thin film of pure manganese which is otained in the required form by electrodeposition upon aluminium foil.

THE GEOLOGICAL SOCIETY OF LONDON.

March 18, 1931.

The following papers were read :—

A Fossiliferous Limestone associated with Ingletonian Beds at Horton-in-Ribblesdale, Yorkshire. By William Bernard Robinson King, O.B.E., M.A., F.G.S.

The paper deals with an exposure of green felspathic grits with associated calcareous rocks in the railway cutting south of Horton-in-Ribblesdale station. The grits have always been referred to the *Green slate* or Ingleton series. The limestone has been known since the Geological Survey Memoir was published in 1890, and has hitherto been considered part of the Ingletonian series.

In 1921, fossils were discovered in the limestone, and recently a large fauna has been obtained which proves to be of Ashgillian age, and closely comparable with the fauna of the Keisley Limestone of Ingletonian grits are of late Ordovician age. as appears at first sight, the discovery means that a considerable thickness of the Ingltonian grits are of late Orovician age. The problems of general stratigraphy that this contention raises are discussed, and it is considered that there is much evidence of a general nature to suggest that, although the limestone is undoubtedly of Ashgillian age, the grits with which it is associated must be considerably older.

Calcareous matter occurs in two forms in the cutting; firs , as the infilling between the grit blocks of a breccia, and secondly, as a crystalline fossiliferous limestone apparently interbedded with the grits.

A detailed study of the limestone, however, shows that it is essentially of the same origin as the calcareous part of the breccia, since it contains angular fragments of grit and occasional flakes of roughly-cleaved green mudstone of a type exactly like the Ingletonian of the neighbourhood. The fossils show no signs of distortion by cleavage.

It is suggested that this is another case of a *Neptunian dyke.* The fissure probably originated in Ashgillian times as the result of an earthquake shock, which caused

bronzes are found to contain an unusually the hard and steeply-inclined grits forming the sea-floor to gape along their bedding planes. As a result, the soft, unconsolidated calcareous mud of Ashgillian age was engulfed into the fissure, where it has hardened to the limestone.

The accumulated evidence points to the Ingletonian of Horton being almost certainly of Pre-Cambrian age.

On the Septal Development and the Genotype of the Coral Genus Petraia *Münster.* By PROF. OTTO H. SCHINDEWOLF, Ph.D. Communicated by Dr. W. D. Lang, M.A., F.R.S., F.G.S.

There is no coral genus which has been so persistently misinterpreted as *Petraia*. It was founded by Münster in 1839 upon small simple corals from the *Orthoceratites*-limestone of Elbersreuth and the *Clymenia*-limestone of Schubelhammer in the Frankenwald (Bavaria), on the supposition that they were gastropods.

The confusion is partly due to Münster's very meagre description and inadequate figures, but also to the fact that he, and all later writers who have described these Bavarian corals, failed to discriminate between the Elbersreuth and Schubelhammer limestones, which, as the Author has previously shown, are of different ages. The former is Upper Silurian (Upper Ludlow), and the latter Upper Devonian. The corals were, therefore, considered to be of the same age, and to be cogeneric, and even conspecific. The diagnoses of *Petraia* are thus framed upon mixed Silurian and Devonian forms, or upon Upper Devonian corals alone, since the latter are much more common.

The Author, by showing that the genotype of *Petraia* is a synonym of *Petraia radiata* Münster, restricts the name to the Upper Silurian species. The Devonian species belong to Pocta's genus *Alleynia*.

Petraia, which is well characterized by its conical shape, deep calice, external ornamentation, arrangement of the septa and in normal specimens, by the absence of transverse tissue, has not been found outside Bavaria. Nevertheless, the name has been applied to genera belonging to various lineages ranging from Ordovician to Permian, and occurring in various parts of the world. A detailed account is here given of the septal development in *Petraia* compared with certain other corals.

THE INSTITUTE OF METALS.

ANNUAL GENERAL MEETING.

March 11 and 12.

The Twenty-third Annual General Meeting of the Institute of Metals was held in London on March 11 and 12, 1931, the President, Dr. Richard Seligman, in the Chair.

The Council, reporting upon the past year's work of the Institute, stated that the year 1930 witnessed an unprecedented disturbance in the economic life of the world. That the Institute of Metals should have been entirely unaffected by such a catastrophe was not expected. For the membership, at such a time, to have increased —from 2,122 to 2,160—and for the Institute's financial position—as revealed in the Treasurer's Report—to have been more than maintained during the period under review, are therefore matters of satisfaction. These encouraging results have been brought about because there has been no relaxation of effort and no waning of interest in the work of the Institute on the part of the members. New ground has been broken in several directions, particularly as regards the publication of the Abstracts section of the " Journal " in monthly instead of in half-yearly parts. New activities have thus been added to those already in being, and these, in their turn, have been fully maintained.

The Council feels that nothing could have justified the existence of the Institute more completely than that it has been able, in a time of such universal stress, thus to extend and increase the efficiency of its services to the science and practice of non-ferrous metallurgy, which services are of such outstanding international importance.

Papers presented :—

The Corrosion of Early Chinese Bronzes. By W. F. COLLINS, A.R.S.M.

A series of objects, classified by their art-forms and ranging from the earliest known periods of the Chinese bronze age, has been analyzed and illustrated. The patina and patination deposits formed by their corrosion are stated to have resulted in formation of definite minerals. A list of minerals hitherto uncertain is given. Conditions leading to formation of such minerals, based on analyses of the loess deposit in which Chinese bronzes are usually found, atmospheric conditions in China, and recent researches on corrosion of copper and bronze, are discussed. The Chinese

The misinterpretation of *Petraia* is particularly unfortunate, since the name is continually used in systematic and phylogenetic literature.
high percentage of lead. This preliminary research is stated to indicate that the bronze metallurgy of the early Chinese is distinct from that of the Sumerians.

An Investigation of the Microstructures of Fifteen Silver Greek coins (500-300 B.C.) and some Forgeries. By C. F. ELAM, M.A., D.Sc.

The microstructure of a number of genuine ancient silver Greek coins is described, together with that of some forgeries. The structure varied considerably, although coins from the same mint and period resembled each other. All the genuine coins showed evidence of striking between dies as opposed to the forgeries, which, with one exception were made by casting only. Analyses indicated that the coins were sometimes made from nearly pure silver, and sometimes copper was added. The forgeries contained copper, and in two cases, zinc.

The Mode of Deformation of a single Crystal or Silver. By H. J. GOUGH, M.B.E., D.Sc.

A single crystal of silver has beeu tested under alternating torsional stresses with the especial object of studying the formation of twin bands. Throughout the tests, however, no definite twin markings were observed, although the surface of the specimen was covered by a completed system of slip-bands in good agreement with the maximum resolved shear stress law. After the specimen had been fractured in torsional fatigue, the test portion of the specimen (containing the crack) was annealed in vacuum with the object of revealing the presence of twins. No signs of twinning was, however, observed. After the completion of the torsional test, compression specimens were machined out of the enlarged ends of the torsion specimen. These specimens were compressed by static and impulsive forces, the maximum strain imposed being about 5 per cent. Again no twin markings were observed, although in every case profuse slip on the most highly stressed octahedral planes were produced.

Some Properties of Metallic Cadmium. By C. H. M. JENKINS, D.Sc., A.R.S.M., with an Appendix on *X-Ray Investigation of Cold and Hot-Rolled Cadmium.* By G. D. PRESTON, B.A.

The physical properties of cadmium were investigated by means of tensile and ball hardness tests as well as by electrical conductivity measurements on "aged" and "heat-treated" material in the cast, forged, and rolled conditions. The research indictates that hardness changes on rolled material which are found to occur at room temperature are markedly affected by conditions of hot- or cold-working. By maintaining cadmium cold during rolling the material possesses properties markedly different from metal which is allowed to warm during this process. In the short-time tensile tests, worked material is found to be stronger than cast material, but under prolonged stress the cast alloys are inferior to rolled samples.

The Constitution of the Cadmium-Rich Alloys of the system Cadmium-Silver. By P. J. DURRANT, M.A., Ph.D.

The constitution of the alloys of cadmium and silver from 0 to 40 per cent. by weight of silver has been reinvestigated by the methods of thermal and micrographic analysis. The liquidus has been found to consist of four smooth curves which intersect with peritectic horizontals at 343°, 592°, and 640°C. In the solid state the system gives rise to the following solid solutions: "I" extending from 0 to 6 per cent. by weight of silver; "II" extending from 18 to 33.5 per cent. by weight of silver; "III" extending from 36.2 to 39 per cent. by weight of silver. The solid solution "II" includes the two solid solutions which Petrenko and Federow described as ζ and δ. The solidus and liquidus of alloys of phase "II" are roughly parallel, and do not intersect, as was previously thought, at 25 atoms per cent. of silver. No transformations below the solidus have been detected in any of the solid solutions, but the examiuation of solid solution "III" has not been carried out below 400°C.

The Solid Solutions of the Copper-Silver System. By D. STOCKDALE, M.A., Ph.D.

The mutual solubilities of copper and silver have been determined, chiefly by the method of examining quenched specimens under the microscope. As this method fails at low temperatures, further information about the position of the phase boundaries was sought by measuring the electrical resistance of quenched wires. A "differential" method which shows up small, abrupt changes in the electrical resistance of alloys at the temperature at which they occur is also described.

Forthcoming Events.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Friday, March 27, at 9 p.m.—"Helium and its Properties." By Sir Ernest Rutherford.

Saturday, March 28, at 3 p.m.—"Alpha-Rays." By Sir Ernest Rutherford.

Monday, March 30, at 5 p.m.—General Meeting.

SOCIETY OF PUBLIC ANALYSTS

The next Meeting of the Society will be held on Wednesday, 1 April, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1, at 8 p.m.

The following papers were read :—

Carbon Monoxide Poisoning : Its Detection and the Determination of the Percentage Saturation in Blood, by means of the Hartridge Reversion Spectroscope. By R. C. Frederick, A.I.C.

Experiments on the Hardness of Fats. By H. M. Mason, M. Sc. F.I.C., and G. Walsh, B.Sc., A.I.C.

A New Process for the Determination of Small Amounts of Bromide in Chloride. By R. S. Evans, M.C., Ph.D., F.I.C.

The Use of Bromine as a Reagent in the Determination of Alkaloids. By S. G. Walton and R. G. O'Brien.

INFORMAL DINNER.—Arrangements have been made for Members and their friends to dine together at St. James's Restaurant, 178, Piccadilly (opposite Burlington House), at 6.30 p.m.

COMPETITION OF INDUSTRIAL DESIGNS.

Particulars of the Eighth Annual Open Competition of Industrial Designs, to be held at the Imperial Institute, South Kensington, London, S.W.7, in June, may now be obtained from the Secretary of the Royal Society of Arts, John Street, Adelphi, London, W.C.2.

Intending competitors must apply to the Secretary of the Society between May 1 and 9 for the necessary entry forms, the last day for receiving entries being May 22. The designs will be received at the Imperial College of Science and Technology, Imperial Institute Road, S.W.7, between June 8 and 10. In all, scholarships and prizes amounting to about £1,600 are offered in connection with the 1931 competition.

PRAGUE SUMMER SCHOOL.

July 20—August 8, at the Prague Summer School, during the long vacation there will be delivered lectures in English in a number of subjects including Literature, Art and Science in Czechoslovakia, the History and Geography of Central Europe, and there will also be language courses in German, Czechoslovak and Russian.

Particulars of the fees for one, two or three weeks, reduced railway fares and other factilities and excursions in connection with the course may be obtained from Dr. B. Trnka, 55, Smetana Square, Prague, Czechoslovakia.

MOTOR EXHIBITIONS.

The Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London, S.W.1 are organising two Motor Exhibitions, which will be held at Olympia, Kensington, London.

These Exhibitions are :

The International Motor Exhibition, October 15-24 (for Private Cars, Carriage Works, Motor Boats, Tyres, Accessories and components and Service and Garage Equipment).

The International Commercial Motor Transport Exhibition, November 5-15. (For Vehicles for Goods and Passenger Transport and general utility purposes; Bodywork, Trailers, Components, Accessories and Tyres; Service and Garage Equipment.)

IDEAL HOME EXHIBITION.

Olympia, London, W.

April 7 to May 2.

The greatest display of Homecraft, Housing, Furnishing and Fashions ever gathered together under one roof will be seen when the *Daily Mail* Ideal Home Exhibition opens at Olympia, London, W., on April 7.

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OIL AND COLOUR CHEMISTS' ASSOCIATION.

Friday, March 27.—Annual Dinner, Connaught Rooms, Kingsway, London, at 7 for 7.30 p.m. Tickets, 12s. 6d., exclusive of wine.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

6,602. I. G. Farbenindustrie Akt.-Ges. —Manufacture of mono- and dicarboxylic acids of the diphenyl series. March 3.

6,919.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of ketones of the anthraquinone series. March 5.

Specifications Published.

343,877.—Herold Akt.-Ges., and Jager, Dr. A.—Manufacture of phenol-formaldehyde condensation products.

343,878.—Halowax Corporation.—Purification of chlornaphthalenes.

344,043.—Rogers, W.P.—Manufacture of hydrogen.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

MONOXOL.

519,612.—Chemical substances used in the manufacture of oils to prevent oxidation.—British Dyestuffs Corporation, Ltd., Hexagon House, Blackley, Manchester. March 11. (Associated).

NOFEO.

520,133.—Chemical substances used in manufactures, and anti-corrosives.—The General Development Trust, Ltd., 38, Gordon Square, London, W.C.1. March 11.

NIFTICIDE.

520,114.—Deodorisers.—The Firm trading as Odourisers, 60 and 62, Bunhill Row, London, E.C.1. March 11.

GRAMMAR OF LOGIC.

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By the Rev. J. E. Roscoe, M.A.

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Surplus Books For Sale
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A list of various Important Scientific Books for Sale at usually ***less than half published prices*** *will be sent on application to the Manager, Chemical News, Merton House, Salisbury Square, London, E.C.4.*

A NEW RADIOACTIVE MINERAL FROM JAPAN.

By SATOYASU IIMORI, JUN YOSHIMURA AND SHIN HATA.

In the spring of 1930, the authors explored the Bijozan Range, Noto peninsula, for rare minerals and discovered a new radioactive mineral as well as very feebly radioactive deposits of laterite and lateritic clays. So far as can be ascertained, the laterite had never been found in Japan, and the occurrence of such a mineral of tropical nature in this quarter impresses itself as a striking feature of the region. The Bijozan Range is a narrow ridge about fifteen kilometers in length, extending in a southwest-northeast direction along the northern margin of Ochigata graben just situated at the neck of peninsula. Stretching along the whole length of the south side slope of the ridge, there appears a greatly exposed and eroded belt of gneissic granite accompanying a great deal of diorite. The above-mentioned deposits of laterite and lateritic clays, which are thought probably to have been derived from the decay, *in situ*, of some kinds of diorite, have been found, in places near both the southwest and northeast ends of the ridge.

The southwest border of the Range reaches near the seasides of Kami amada and Ichinomiya Villages, where on the shore an immense number of large blocks of gneissic granite and diorite exist, penetrated by narrow dykes of pegmatite. Our attention was directed to the pegmatite attached to these blocks of granitic rocks lying on the shore of Shibagaki, especially of Nagatejima, a small narrow headland jutting out from the coast of Shibagaki, and there has been found the above-stated radioactive mineral occurring irregularly disseminated through the dyke mass of pegmatite. The occurrence of this mineral is, however, very small.

PHYSICAL PROPERTIES.

The mineral occurs in black prismatic crystals of 6-7 mm. long and 2-3 mm. across, sometimes in massive lumps of tabular nature, several of which have a diameter of about 5 mm. occasionally of about 15 mm. It has a resinous lustre and a hardness of 5.5. The fracture is uneven. It is rather brittle and opaque. The powder and the streak have a pale brown colour. The mineral is biaxial and displays a weak pleochroism. The optical properties

have been measured, the mineral provisionally being assumed to have a crystallographic constitution analogous to that of allanite. Thus, the pleochroism was observed as X, brownish yellow. The specific gravity was determined with a pycnometer as 3.91. The goniometric measurements were made by Mr. T. Yoshimura of Mineralogical Laboratory, Tokyo Imperial University, to whom the authors wish to express their thanks for hisr kindness. The forms present are *a*(100), *c*(001), *r*(101) and *l*(201). The mineral bears a close resemblance to allanite, yet is not in exact agreement with the latter in some respects.

Chemical Composition.

Treated with hydrochloric acid, the mineral is easily decomposed leaving a white flocculent residue. Before the blowpipe it fuses with slight intumescence to a magnetic globule, which is also readily decomposed by hydrochloric acid, and the latter fact is a difference from allanite.

Analysis.—The material for the analysis was sorted from the well developed crystals which were broken up and carefully freed from adherent gangues. A brief outline of the method of analysis may here be noted. The mineral was decomposel with concentrated hydrochloric acid. The residue, insoluble in hydrochloric acid, was ignited and weighed. The ignited residue, which chiefly consisted of silicic acid as well as of a small amount of titanic acid and rare earths, was treated with hydrofluoric acid and sulphuric acid to remove the silica, and then fused up with sodium pyrosulphate. The fused mass was leached out with dilute sulphuric acid and it passed completely into solution (A). To the filtrate from the original hydrochloric acid treatment an excess of ammonia was added, and the precipitates of hydroxides yielded were filtered. On the ammoniacal filtrate, the manganese, calcium, and magnesium were determined in the usual way. The hydroxides, previously obtained on the addition of ammonia, were again dissolved in concentrated hydrochloric acid (the solution B). The two solutions A and B were united, and the rare earths and thorium were precipitated by oxalic acid from the acidified solution. The precipitates of rare earths, thus obtained, were filtered, converted into nirates, and twice precipitated with hydrogen peroxide to separate the thorium from the rare earths. The cerium was then separated by means of potassium bromate and iodate from the remaining rare earths, which were subsequently fractionated into the lanthanum-neodymium earths and yttrium earths having been treated with potassium sulphate.

The iron, aluminium, titanium as well as phosphoric acid were all together precipitated by ammonia in the filtrate from rare earths, after the decomposition of oxalic acid. The precipitates were filtered and fused with sodium carbonate after the addition of a little silica, and leached out with a solution of ammonium carbonate. The extraet obtained was acidified with hydrochloric acid, and after the removal of silica, was used for the determination of phosphoric acid which was thrown out by magnesia mixture. The residue, insoluble in the ammonium carbonate solution, was roasted and fused again with sodium pyrosulphate, and the total iron was titrated by a standard solution of potassium permanganate. On the same solution, the titanium was colorimetrically determined, and finally the aluminium was estimated by the weight difference. The ferrous iron was determined in the usual way on a separate sample. The results are shown below :—

	Per cent.	Molecular ratios. (1)	(2)
SiO_2	25.2	9.28	6.00
TiO_2	0.57	1.00	
P_2O_5	6.48		
Al_2O_3	14.3	5.13 (R_2O_3)	3.00
Fe_2O_3	2.40		
Ce_2O_3	14.58		
La_2O_3, etc	7.48		
Y_2O_3 etc.	4.51		
ThO_2	0.88		
FeO	7.89	7.33 (RO)	4.28
MnO	1.12		
CaO	10.4		
MgO	1.04		
H_2O-	0.22	3.08	1.82
H_2O+	2.35		
	99.79		

Chemical formula. — Combining the molecular ratios of all the divalent and trivalent basic radicals respectively and the ratio of silica with that of titanic oxide, as shown in the table above, we have the ratios (1), whilst combining all of the acid radicals including phosphoric acid, the other ratios (2). The ratios (1) are of no significance, but the ratios (2) give a formula

entirely analogous to that of allanite belonging to the epidote group suggested by G. Tschernick, namely :—

Epidote	$4CaO.3(Fe, Al)_2O_3.6SiO_2.H_2O$
Allanite	$4R''O.3R'''_2O_3.6SiO_2.2H_2O$
This mineral	$4R''O.3R'''_2O_3.6(SiO_2, P_2O_5).2H_2O$

where R'' = Ca, Fe; R''' = Ce, La, Y, Al, Fe (and Th). From this analysis, it will be seen that the mineral is, essentially, a hydrous phosphosilicate of the cerium earths, aluminium, iron and calcium. The mineral is, therefore, evidently a new species belonging to the epidote group, and the authors would suggest the name "*Nagatelite*" for it, after the name of locality where the mineral was first discovered. Its weak radioactivity is ascribed to its containing a small amount of thorium.

MINERALS ASSOCIATED WITH NAGATELITE.

An intensely radioactive mineral.—Imbedded in a large crystal of biotite occurring in the same pegmatite dykes, has been found a minute grain of pitch black mineral with a resinous lustre measuring about 2 mm. in diameter. The streak is jet black. It shows an intense radioactivity and is easily soluble in hot nitric acid (1 : 1). The measurement of density was carried out on 0.0033 g of the sample using small pycnometer. The average of four determinations was 9.4. It has been ascertained by the ferrocyanide reaction that the mineral contains a marked amount of uranium but no iron. The material was, however, too scanty for analysis. From the above stated qualitative examination as well as its physical properties, though we could not fully investigate its chemical nature, it may be concluded that the mineral belongs to either one of uraninite, bröggerite or thorianite.

Magnetite.—Magnetite is fairly abundant, occurring as pretty octahedral crystals or crystalline lumps measuring sometimes about 2 cm across. The conspicuous presence of this mineral is a noticeable feature of the pegmatite in this region. An analysis made on a selected material gave the following results :—

	Per cent.
Fe_2O_3	58.19
FeO	30.78
Al_2O_3	2.45
CaO	0.37
SiO_2	4.71
TiO_2	3.42
Total ...	99.92

Biotite.—Lumps of biotite crystals are frequently found in the pegmatite dykes attached to the blocks of granitic rocks.

Feldspar and hornblende.—These occur as the principal constituents of the pegmatite and diorite respectively. The feldspar is mostly of flesh colour and predominantly orthoclase, whilst that constituting the diorite is probably andesine or labradorite as it partially dissolves in hydrochloric acid and gives distinct reactions of calcium.

The authors are much indebted to Mr. I. Okada for his kind advices given on the microscopic measurements.

THE ELECTROLYTIC PRODUCTION OF HYDROGEN AND HYDROXIDES.

By R. SAXON, B.Sc., F.C.S.,
Mem. Soc. Chem. Ind.,
Mem. Amer. Chem. Soc.

CHROMIUM.

Chronium is decidely amphoteric in its oxides forming salts of the metal as base, and as acid. Unlike any other element in this dual capacity both types of salts are strong compounds, both chromium salts and chromates are common and stable, and the latter cannot be regarded as oxidizing compounds even among the bichromates as is the case with the permanganates, or manganates. This characteristic shows itself plainly under electrolysis.

Electrolyte water without "seasoning" of any kind.

Electrodes, Anode chromium, connected up with platinum foil.

Cathode any metal, or carbon.

Current voltage, 240. Lighting-circuit wire.

Over the cathode is placed a boiling tube filled with water to collect the gas that comes off.

The action is vigorous and the cathode tube fills with hydrogen of very pure nature in about twenty minutes from switching on the current, which is considerable less than the time required to set up the usual hydrogen generator. Events take place as follows,

1. A yellow colouration rushes up the cathode tube with the gas. There is no indication whatever of the green or purple chromic hydrate, or the blue gel chromous hydrate.

2. The electrolyte rapidly assumes the rich chromate yellow colour. This colour is deep. The electrolyte boiled down deposits chromic oxide CrO_3, soluble in water,

giving precipitates of chromates with lead acetate, or barium chloride. Warmed with potassium hydroxide the salt potassium chromate results obtainable in crystalline form by evaporation. The solution gives the same precipitate with lead and barium salts.

3. The anode on the side facing the cathode takes on a red colour. This proves in a similar way to be the chromic oxide. It readily comes away to potash, giving the *chromate*.

4. The red colour on the anode turns violet. Round the anode there are stains of golden yellow, due probably to coating of chromic oxide. The violet colour is probably due to reduction after leaving the electrolyte, to the sesquioxide. The violet is a decided one of a definitely neutral velvet purple tone. It has neither blue nor red leaning, but like the petals of the purple flower, the viola.

Conclusion. Chromium under electrolysis of water as anode gives chromic acid oxide, without the sesquioxide. It shows a marked preference for oxygen over manganese, and follows the rise in oxygen affinity in the series, copper. nickel, cobalt, iron, manganese, chromium.

BRITISH IRON AND STEEL PRODUCTION IN FEBRUARY.

The National Federation of Iron and Steel Manufacturers reports that 320,200 tons of pig iron were produced in February, as compared with 337,200 tons in January, 607,000 tons in February, 1930, and a monthly average of 855,000 tons in 1913.

The February production of pig iron included 82,400 tons of hematite, 124,900 tons of basic, 86,900 tons of foundry and 13,700 tons of forge pig iron.

Furnaces in blast at the end of February numbered 81, a net decrease of two since the beginning of the month, four furnaces having ceased operations, and two having commenced.

The February production of steel ingots and castings amounted to 486,400 tons, as compared with 402,200 tons in January and 376,400 tons in February and a monthly average of 638,600 tons in 1913.

PRECIOUS STONES FROM AN OVEN.

By George Biesenthal.

A long row of ovens stand in neat halls. One thinks for a moment of the alchemists, of sorcerers in witches' kitchens, and expects to see mystic forms in black robes and pointed hats. But one sees only ordinary workmen at the bellows, regulating the temperature and looking through an opening into the glow of an oven heated to a temperature of 3,600 degrees fahrenheit. *Into the ovens go different kinds of earth* and oxygen; out of them come precious stones. It is the precious stone factory in Bitterfeld.

It is an age of substitutes—but substitutes need not always be decried. Substitutes of high quality within the reach of all can be of more value than the guenine articles avaiable to only a few. And these "artificial" stones are not *imitations.* They are synthetic jewels, which grow precisely as they grow in nature's great factory, and contain the same materials as the stones found in Ceylon, Siam, or wherever it may be. The only difference is that their production is here not left to the blind play of natural forces, and that the process is speeded up. It takes nature tens of thousands of years to make a precious stone weighing only a few carats, but this Bitterfeld factory produces stones of 150 to 200 carats in a few hours.

Analytical chemistry long ago showed that the material of which valuable stones consist is in itself not at all valuable. The diamond is nothing but "plain" carbon; rubies and sapphires contain oxygen and aluminium earths which are present in nature in vast quantities. The value of these stones depends on their makeup. If one studies such a stone before it is cut, one finds in almost every case a regular form. Diamonds form octahedrons or cubes; rubies and sapphires hexahedrons and hexagonal bars. We have to do with crystals, and it is this crystalline condition that converts worthless materials into objects of value and beauty, giving them their brilliance and translucence. The problem of making such stones synthetically therefore resolved itself into the making of crystals.

Thirty years ago Verneuil in Paris and Wild and Miethe in Germany succeeded in crystallizing the ground materials. The main stones produced today are rubies and sapphires. Diamonds and emeralds have

been manufactured, but the gems produced are so tiny and the cost of production is so high that the process is unprofitable. The production is in the hands of the " I. G. Farben," the great German dye trust.

It is highly skilled work. The crystal grows in the klowing oven, becoming larger from minute to minute. A high degree of skill, experience and self-reliance is required of every workman to make possible the manufacture of a large, clear, evenly coloured stone. From the first to the last second constant observation is necessary, and the heat must be regulated carefully. about 3,600 degrees Fahrenheit. The melting apparatus contains a burner with a tube through which hydrogen and oxygen are introduced, together with a small magazine containing powdered earths and colouring material. Minute quantities of these materials are impacted against a small pencil of fire-resisting substance and melts there. As material is added it grows larger and assumes a pearshaped form. The crystallizing force is so great that these drops at times even take on crystal-form outwardly and become a six-sided prism at the top.

Several millions of such stones are produced every year. But they are not used merely for ornaments. On the contrary, they are chiefly employed in the making of technical apparatus, since, they correspond precisely to natural stones in their chemical, physical and optical makeup. Synthetic corundum possesses the ninth degree of hardness, precisely like the natural stone, exceeded in hardness only by the diamond, with a grade o ften. They are used for bearings, in watches, instruments of precision, electrical meters, etc. Boring tools used in boring for potash, salt ,etc., are pointed with these hard stones, and the carborundum dust furnishes a valuable abrasive material.

BRITISH SHIPPING MOVEMENTS AT BRITISH PORTS.

Figures for January show, as regards the foreign trade, decreases of 5.7 and 23.3 per cent. respectively in the net tonnage of arrivals with cargo and in ballast at United Kingdom ports as compared with January, 1930, and of 18.9 and 0.1 per cent. in departures. Coasting trade returns reveal declines of 2.7 and 4.2 per cent. respectively in arrivals and departures with cargo and of 9.4 and 8.0 per cent. in ballast.

COMBINED STEAM POWER AND HEATING.

ANOTHER EXAMPLE OF EFFICIENT USE OF EXHAUST STEAM.

(By a Well Known Engineer).

In view of the extensive development in Great Britain of superpower stations and the grid system for the supply of electricity it must be emphasised that in very many chemical and other industrial establishments electricity can be generated at a much cheaper rate by the combined steam power and heating principle. This method, as now more or less well known, involves generating steam at a moderately high pressure, passing it through an engine or turbine developing the required electrical (or other type of) power, and exhausting to the low pressure mains. That is, only one boiler plant is required for the two requirements of power generation and process work the nett result being much more efficient than using low pressure boilers for the latter purpose, and buying electricity from an outside supply.

The reason is that the additional heat required to raise steam at a higher pressure, because of the latent heat, is so small as to be negligible, while the heat actually taken by the engine or turbine to produce the power is only about 5 per cent. of the total contained in the steam. In addition to process operations many industrial establishments can be heated on the most economical lines by the exhaust steam from engines instead of discharging this to the air or throwing it away in condensers where about 60 per cent. of the heat in the coal is lost in the cooling water, 450-500 tons being required for every ton of coal burnt in the boilers.

A typical installation in this connection is at Sentinel Waggon Works, Shrewsbury, comprising two " Belliss " back pressure engines, each 200 K.W. capacity. These engines exhaust to a heating system designed and erected by Hopes Heating and Lighting, Ltd., Birmingham, which comprises 34.000 feet of cast iron piping for the distribution of the steam to 118 radiators, the total floor area amounting to 181,000 square feet.

The exhaust steam from each engine is taken to a collecting header from which it passes through an oil separater to the heating main, while a live steam make-up is provided through a 3in. by 6in. reducing valve, entering the low pressure main after the oil separater. Approximately

10,000 lbs. of exhaust steam per hour are used in practice at the Sentinel Works, the pressure of the engine exhaust branch being 3 lbs. per square inch guage. For the distribution of the steam 12in. diameter pipes are used, the return main being of 5in. diameter. Also a vacuum pump is employed to remove the condensed steam which is discharged to a tank and used as boiler feed water, and from the 12in. main steam is led away to calorifiers through 6in. piping to provide hot water.

It is essential, however, that the correct type of plant should be installed for the prevailing conditions, and in this connection it may be stated that Belliss and Morcom, Ltd., of Birmingham, have specialised for over thirty years on back pressure, as well as pass-out, engines and turbines, representing an experience that includes nearly 100 different industries while two other important fields are steamships and the heating of large buildings, while at the same time generating electricity for lighting.

KEY INDUSTRIES.

A representation has been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding Sodium ethyl methyl butyl barbiturate.

Section 10 (5) of the Finance Act, 1926, is as follows :—

> " The Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act, 1921, as amended by this Act, for such a period as may be specified in the order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that there is no reasonable probability that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Any comunication should be adressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, S.W.1, within one month from the date of this notice.

17th March, 1931.

GENERAL NOTES

CANADIAN NON-METALLIC MINERAL PRODUCTS.

The Dominion Bureau of Statistics at Ottawa in a Report on the Manufactures of Non-Metallic Minerals in Canada in 1929 records an increase of $36,000,000 in production as compared with the returns for 1928. The value of the 1929 output was $242,023,518 produced by 1,173 factories representing a total capitalisation of $329,448,844, and employing 31,431 workers. Firms in this group were classified into 15 different industries and only one of these showed a lower output value in 1929 than in the preceding year. Petroleum products advanced $16.3 millions to $99,408,314; coke and gas gained $5.2 millions to $39,910,443; cement, $2.6 millions to $19,337,235; glass $2 millions to $15,507,442; abrasives and abrasive products, $1.8 millions to $8,961,951; aerated waters, $1.1 millions to $12,249,218; products from domestic clays, $1.5 millions to $13,904,643; stone dressing, $1.1 millions to $8,224,060; production from imported clays, $0.9 millions to $3,373,038. Cement products at $4,419,417 and asbestos products at $2,286,638, each showed a gain of about $250,000, and the salt industry recorded a slight advance to $1,578,086. Sand-lime brick declined in value to $953,726 from $1,112,466 in 1928.

Imports into Canada of non-metallic minerals and their products totalled $185,921,799 in value, as compared with $162,172,427 in 1928. The totals include both coal and petroleum. Exports from Canada during the year were valued at $29,719,996, as against $26,583,611 in 1928, exports of asbestos and products thereof accounting for $12,748,634 in 1929.

UP-TO-DATE CANADIAN INSTRUMENTS.

The draw-tube telescope as part of an instrument for taking the levels of the earth's surface, is obsolete. The interior focussing telescope is now utilized by the Geodetic Survey of Canada, Department of the Interior, exclusively on precise and control levelliug operations. The new type was first introduced on Canadian surveys in the year 1913 and results obtained ultimately led to its adoption for all high order levelling.

RETURN OF THE TRADE MISSION TO EGYPT.

The Department of Overseas Trade announces that the United Kingdom Trade Mission to Egypt has completed its investigations and has now returned to London.

The Mission left this country on 31 January to examine and report on the position of trade between the United Kingdom and Egypt, and has for its personnel Sir Arthur Balfour, K.B.E. (Chairman), Sir Alan Garrett Anderson, K.B.E., Mr. W. R. Blair, and Mr. Kenneth Lee.

The Mission left Port Said by the P. and O. S.S. "Naldera," and arrived at Victoria Station at 3.30 p.m. by the boat train from Marseilles.

Sir Arthur Balfour, K.B.E., and the other members of the United Kingdom Trade Mission to Egypt met the Overseas Trade Development Council on Wednesday, 18 March, to discuss what action should be taken to make the Mission's work as effective as possible.

METHODS OF TRADING, ETC., IN DENMARK.

A Memorandum containing information as to the methods of trading and terms of payment prevailing in relation to business with Denmark, together with notes on the general features of the market, prepared by the Commercial Secretary to H.M. Legation at Copenhagen, has been received and issued by the Department of Overseas Trade to firms whose names are on its Special Register.

British firms who desire to obtain a copy of the Memorandum and particulars of the Special Register service should apply to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference No. C.X 3463 should be quoted.)

THE B.I.F. OF 1930.

Attendances of home buyers showed an increase of 30,000 over last year. Overseas buyers, who totalled about 25 per cent. more, and came from 75 countries, as against 70 in 1930. The President of the Board of Trade observes that home manufacturers, Empire producers and the world's buyers have adopted the Fair as part of their commercial organisation.

CHEMICALS REQUIRED FOR ROUMANIAN GOVERNMENT.

The Roumanian Commercial Attache in London has informed the Department of Overseas Trade that a competition will be held on the 6 April, 1931, for the supply of "a very considerable quantity of chemicals," required for various State departments in Roumania.

Apparently only one copy of the cahier des charges is available in the United Kingdom and this copy may be consulted at the office of the Roumanian Commercial Attache, 4, Cromwell Place, London, S.W.7, between the hours of 11 a.m. and 1 p.m.

No further particulars with regard to call for tenders are available in the Department of Overseas Trade.

TENDERS FOR DISINFECTANT FLUID FOR NEW ZEALAND.

His Majesty's Trade Commissioner at Wellington reports that the New Zealand Government Stores Control Board is calling for tenders, to be presented in Wellington by the 25 May, 1931, for the supply of disinfectant fluid.

Firms desirous of offering disinfectant fluid of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference F.X. 1073 should be quoted.

BALTIC STATES.

Methods of Quoting and Terms of Payment.

A confidential memorandum on methods of quoting and terms of payment prevailing in relation to business with the Baltic States which has been prepared by His Majesty's Consular Officers at Tallinn, Riga and Kovno has been received and issued by the Department of Overseas Trade to firms whose names are on its Special Register. British firms, who desire to obtain a copy of the memorandum and particulars of the Special Register should apply to the Department. (Reference number C.X. 3477 should be quoted.)

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, March 19.

The following papers were read :—

The Cinchona Alkaloids and Substances related to them. Introduction and Part I. Some Piperidinomethylcarbinol Hydrochlorides. By MISS R. V. HENLEY AND E. E. TURNER.

The synthesis is described of a number of compounds of the type Ph.CR(OH).NC_5H_{10}, which bear pictorial resemblance to the cinchona alkaloids, and also of two other compounds of the general formula Ph.CO.CHR.NC_5H_{10}. These have been made in order to obtain information as to the group or groups responsible for the anti-malarial action of the alkaloids.

The Optical Resolution of 3 :5-Dinitro-6-α-Naphthylbenzoic Acid. By MISS M. S. LESSLIE AND E. E. TURNER.

This acid has been prepared by a method similar to that used for 2 : 4-dinitro - 2′ - methyldiphenyl - 6 - carboxylic acid, and has been resolved.

A New Reaction of Certain Diazosulphonates Derived from β-Naphthol-1-Sulphonic Acid. Part IV. The Constitution of the Condensation Products of Diazo-Compounds with β-Naphthol Derivatives Substituted in the 1-Position. By F. M. ROWE AND A. T. PETERS.

Diazo-compounds condense with β-naphthol-1-sulphonic acid in acid solution to form comparatively stable aryl-2-naphthol - 1 - diazosulphonates quantitatively. The latter, on treatment with a limited quantity of alkali, give very reactive substances, some of which are converted by sodium hydroxide into complex phthalazine derivatives, and all of which are converted quantitatively into the corresponding azo-derivatives of β-naphthol, with elimination of the sulphonic group, by acidifying a cold aqueous solution. Bucherer (*Ber.*, 1909, XLII, 47) and Wahl and Lantz (*Bull. Soc. chim.*, 1923, XXXIII, 97) regarded these reactive substances as diazo-oxides, but the above results indicated that they are sodium - 1 - arylazo - β - naphthaquinone -1-sulphonates (*J.*, 1926, 690; 1928, 2556; and following papers). Such a hemi-quinonoid formula was limited to derivatives of β-naphthol-1-sulphonic acid. Pollak and Gebauer-Fülnegg (*Monatsh.*, 1928, L, 314) have suggested the possibility of the simultaneous existence of the diazo-oxide and hemi-quinonoid types, one or other form predominating in a particular case. Re-examination, however. indicates that the condensation products of diazotised *p*-nitroaniline with 1-halogeno- or methyl-β-naphthols are diazo-oxides, whilst the condensation products with β-naphthol-1-sulphonic acid are solely of the hemiquinonoid type. Bucherer and Tama (*J. pr. Chem.*, 1930, CXXVII, 39) consider that their study of the condensation product of diazotised *p*-nitroaniline and β-naphthol-1-sulphonic acid supports the diazo-oxide formula, but their observations give no reason to doubt that sodium 1-4′-nitrobenzeneazo-β-naphthaquinone-1 -sulphonate is the correct constitution. Some of their statements are corrected, and their "readily soluble" and "sparingly soluble" yellow compounds are shown to be sodium hydrogen 3-(4′-nitrophenyl)-1 : 3-dihydrophthalazine-4-acetic acid-1-sulphonate and 1-hydroxy-3-(4′-nitrophenyl)-1 : 3-dihydrophthalazine-4-acetic acid respectively.

Part V. The 4′-Nitro- and 4′-Amino-derivatives of 4-Methyl-3-phenylphthalaz-1-one. By F. M. ROWE, E. LEVIN, AND A. T. PETERS.

The products of the action of cold acid dichromate on 1-hydroxy-3-(4′-nitrophenyl)-1 : 3-dihydrophthalazine-4-acetic acid and 1-hydroxy-3-(4′-aminophenyl)-tetrahydrophthalazine-4-acetic acid are *4-methyl-4′-nitro-3-phenylphthalaz-1-one* and the corresponding *amino*-compound, respectively. The latter is formed also by refluxing the acid with alcoholic potassium hydroxide, or by reducing the former with sodium sulphide. The course of the degradation of these phthalazine derivatives depends on the conditions employed. Thus boiling with aqueous mineral acid eliminates acetic acid and the >CH.OH group in position 1 is converted into a keto-group, giving 4′-nitro and amino-3-phenyl phthalaz-1-one respectively, but with cold acid dichromate the acetic acid side-chain is decarboxylated. As the amino-acid is also decarboxylated by boiling alkali, the behaviour with acids and alkalis is the converse of that of acetoacetic ester. Reduction of 4-methyl-4′-amino-3-phenylphthalaz-1-one with zinc dust and hydrochloric acid gives *3-methyl-4′-amino-N-phenylphthalimidine.*

Part VI. Preparation of Phthalazine, Phthalazone, and Phthalimidine Derivatives from 2 : 6-Dichloro-4-nitroaniline. By F. M. ROWE AND C. DUNBAR.

2′ : 6′-Dichloro-4′-nitrobenzene-2-naphthol - 1 - diazosulphonate is converted through *sodium* 1-2′ : 6′-*dichloro-4′-nitrobenzeneazo-β-naphthaquinone*-1-*sulphonate* into *sodium hydrogen* 3-(2′ : 6′-*dichloro - 4′ - nitrophenyl*) - 1 : 3-*dihydrophthalazine-4-acetic acid*-1-*sulphonate* less readily than in the case of the unhalogenated analogue. The main influence of the chlorine atoms usually is to render some subsequent stages of degradation more difficult and to diminish the yields. Replacement of the sodium-1-sulphonate group by hydroxyl gives 1 - *hyroxy* - 3 - (2′ : 6′ - *dichloro* - 4′ - *nitrophenyl*) - 1 : 3 - *dihydrophthalazine* - c-*acetic* acid, which is reduced satisfactorily to 1-*hydroxy*-3-(2′ : 6′-*dichloro-4′-aminophenyl*) - *tetrahydrophthalazine* - 4-acetic acid by stannous chloride and hydrochloric acid, but not by alkaline hyposulphite, owing to the subsequent action of alkali on the amino-acid. The hydrochloride of the latter is unaffected by prolonged boiling with hydrochloric acid, but conversion into 2′ : 6′-*dichloro-4′-amino-3-phenylphthalaz-1-one* proceeds readily with aqueous sulphuric acid (b.p. 140°). Reduction of this with zinc dust and hydrochloric acid gives 2′ : 6′-*dichloro* - 4′ - *amino* - N - *phenylphthali* - *midine*, but some 2 : 6-dichloro-*p*-phenylenediamine also is formed by fission, although no chlorine is eliminated.

1-Hydroxy-3-(2′ : 6′-dichloro-4′-nitrophenyl)-1 : 3-dihydrophthalazine-4-acetic acid is converted by aqueous sulphuric acid (b.p. 140°) into 2′ : 6′-*dichloro-4′-nitro-3-phenylphthalaz*-1-*one*, which resembles the unchlorinated analogue in most of its general properties. Although the methylation product combines with alcohols to form dialkyloxy-derivatives, these differ from the corresponding derivatives of 4′-nitro-3-phenylphthalaz-1-one in that heating does not give 4-keto-1-methoxy - 3 - (2′ : 6′ - dichloro - 4′ - nitrophenyl)-3 : 4 - dihydrophthalazine, but merely removes alcohol, forming a *monomethoxy*-compound, which requires further investigation.

Cold acid dichromate converts 1-hydroxy - 3 - (2′ : 6′ - dichloro-4′-nitrophenyl) - 1 : 3 - dihydrophthalazine - 4 - acetic acid, and 1-hydroxy-3-(2′ : 6′-dichloro-4′-aminophenyl) - tetrahydrophthalazine-4-acetic acid very readily into 4-*methyl* - 2′ : 6′ - *dichloro* - 4′-*nitro-3-phenylphthalaz*-1-*one* and the corresponding *amino*-compound respectively.

The latter is formed equally well by heating the acid with aqueous sodium hydroxide, or by reducing the former with sodium sulphide.

Part VII. Preparation of Phthalazine, Phthalazone, and Phthalimidine Derivatives from 2 : 6-Dibromo-4-nitroaniline. By F. M. ROWE AND N. H. WILLIAMS.

Sodium hydrogen 3-(2′ : 6′-*dibromo-4′-nitrophenyl*) - 1 : 3 - *dihydrophthalazine-4-acetic acid*-1-*sulphonate* has been prepared and submitted to reactions similar to those described for the corresponding dichloro-compound (preceding paper). In many cases the results confirm those obtained with the dichloro-compound. When 2′ : 6′-*dibromo-4′-amino-3-phenylphthalaz*-1-*one* is reduced with zinc dust and hydrochloric acid under conditions which have been successful for converting other aminophenylphthalazones into amino-*N*-phenylphthalimidines, however, 4′ - amino - *N* - phenyl - phthalimidine is the main product. By varying the conditions some 2′-bromo-4′-N-phenylphthalimidine is formed, but elimination of bromine cannot be prevented entirely. Similarly 4-*methyl*-2′ : 6′-*dibromo-4′-amino-3-phenylphthalaz*-1-*one* gives 3-*methyl-2′-bromo-4′-amino-N-phenylphthalimidine* and 2 : 6-dibromo-*p*-phenylenediamine. This elimination of bromine is of interest, as a similar reduction of 2 : 6-dibromo-4-nitroaniline gives solely 2 : 6-dibromo-*p*-phenylenediamine.

Strychnine and Brucine. Part XII. The Constitution of Dinitrostrycholcarboxylic Acid. By K. N. MENON AND R. ROBINSON.

It has been found possible to apply the Curtius transformation to the hydrazides derived by condensation of the methyl ethers of dinitrostrychol and trinitrostrychol with hydrazine. This affords a clear proof that dinitrastrychol is a carboxylic acid and consequently Tafel's dinitrostrycholcarboxylic acid is a dicarboxylic acid. In view of the degradation to dinitroisatin already described (Part X) the substance must be 5 : 7-*dinitroindole*-2 : 3-*dicarboxylic acid*.

No modification of the formulæ already put forward is required by this development in itself, but a small structural change is required to accommodate the view of Leuchs that the nitrogen atom joined to the aromatic nucleus in strychnine (N—a) is attached to a methylene group.

THE INSTITUTE OF METALS.

ANNUAL GENERAL MEETING.
March 11 and 12.

The Influence of Pressure and Temperature on the Extrusion of Metals. By C. E. PEARSON, M.Met., AND J. A. SMYTHE, Ph.D., D.Sc.

The paper describes experiments made in a small press on the extrusion-phenomena of the metals lead, cadmium, bismuth and tin. The mechanism of the flow of metal during extrusion by the direct and inverted methods has been studied, and some attention has been given to certain of the extrusion-defects met with in technical practice, and the work of former authors in this field has been confirmed and extended. The chief part of the work is concerned with the determination, under precise control, of the relationship between the rate of extrusion, pressure, and temperature.

Dimensional Stability of Heat-treated Aluminium Alloys. By J. D. GROGAN. B.A., AND D. CLAYTON, B.Sc.

Careful search has failed to reveal the occurrence of secular change in certain commercial heat treated aluminium alloys, subsequent to the completion of the normal ageing process. Serious dimensional changes occur when machining operations are carried out on material quenched in cold water. These changes are reduced to relatively small proportions in "Y"-alloy and Duralumin, the only alloys examined in this way, by the employment of boiling water as quenching medium. Cold cotton-seed oil produces intermediate effects. These alloys, when quenched in boiling water, develop satisfactory mechanical properties.

The Deformation of Metals under Prolonged Loading. Part I.—The Flow and Fracture of Aluminium. By PROFESSOR D. HANSON, D.Sc., Vice-President, AND M. A. WHEELER.

Introduction.—It is known that metals subjected to static stresses for long periods of time will fail under tensile loads less than those necessary to break them quickly. The present paper describes experimental work carried out with a view to studying the mechanism of flow and fracture under prolonged loads.

Method of Investigation.—The principal method used has consisted in examining the changes in micro-structure of polished specimens, subjected to static stresses at room and elevated temperatures. Aluminium was chosen principally because it exhibits the phenomena of "creep" at moderate temperatures, at which a polished surface capable of revealing the microstructural features of deformation can easily be preserved. A further advantage of this metal is that the mechanism of its deformation under many other types of stressing has already been studied. Specimens consisting of ordinary aggregates of crystals, of crystals of widely differing size, and of single crystals have been used. Measurements of the densities of the broken test-pieces have also been made. A few experiments have also been made with lead.

Conclusions.—(1) The extension under a prolonged load that will ultimately break the metal may be conveniently considered as consisting of three periods: (*a*) A period of primary extension, during which the rate of flow diminishes; (*b*) a period during which flow is very slow or even suspended; (*c*) a period during which the extension again continuously increases until fracture occurs. (2) During the first period the flow of the metal is the reisult of slip within the crystals, and flow diminishes owing to the hardening effect of slip. (3) The behaviour during the second and third periods varies with different specimens. (4) Three types of failure have been recognised under creep conditions: (*a*) Failure by intercrystalline cracking; cracks form while the elongation is low, and the metal fails with little reduction of area at the fracture; (*b*) failure by the resumption of slipping within the original crystals, leading to a fracture of the normal tensile type; (*c*) failure through the recrystallisation of the metal, removing strain hardening and permitting further flow of the softened metal; the metal pulls out to a point fracture, with a high elongation. (5) Aluminium can fail by "creep" at room temperature, (6) Aluminium consisting of uniform aggregates of crystal fails at 250° C. by intercrystalline cracking. (7) Aluminium aggregates at room temperature, and aluminium single crystal specimens at all temperatures, fail under creep conditions by shear along the slip planes. (8) In single crystals when flow recommences slip occurs only on some of the surfaces that had previously slipped during the primary flow. (9) The prolonged action of a suitable stress can cause disintegration of a metal either at the junctions of the grains or on surfaces of previous slip, and failure (*i.e.*, fracture) must be regarded as having commenced when this weakening occurs. (10) Under suitable conditions, *e.g.*, in crystal aggregates with moderate rates of

flow at 250° C., or with very slow rates of flow in single crystals, slip is distributed over a very large number of slip surfaces, and a polished surface of the metal may show little or no signs of slip bands. (11) No change in density is believed to occur when a crystal is distorted by moderate amounts : changes in density in the case of crystal aggregates are thought to occur at grain boundaries. (12) The view is expressed that rupture of the crystals commences along slip planes formed at an early stage in the deformation of the metal. (13) The results are consistent with the theory of slip and rupture previously advanced by Gough, Hanson, and Wright.

The Effect of Artificial Ageing upon the Resistance of Super-Duralumin to corrosion by sea-water. By Dr. -Ing. K. L. Meissner.

Corrosion tests were carried out in the North Sea between high and low watermarks with strips of super-Duralumin, 2mm. thick (Duralumin containing 0.8 per cent. silicon) for 3 months. The strips were prevously annealed for 20 minutes at 500° C., quenched in cold water, aged at least 5 days at room temperature, and tempered for 20 to 40 hours from 50° to 200° C. A different " pock-form corrosion," combined with highly delterious effect on the tensile properties, and primarily caused by intercrystalline corrosion, was found in an intermediate range of temperature at 125-145° C., and especially at 140° C. Strips which were artificially aged at lower or at higher temperatures, although also attacked by intercrystalline corrosion, showed no pocks, but still had a relatively smooth surface.

Investigation of the Effects of impurities on Copper. Part VII. The Effect of Antimony on Copper. Part VIII. The com-Effect of Antimony and Arsenic on Copper. By S. L. Archbutt, F.I.C.

The paper forms another section of the research in progress for the British Non-Ferrous Metals Research Association and describes a systematic investigation into the effects of antimony, and the combined effect of antimony and arsenic, on copper in the absence so far as could be obtained, of oxygen and other elements. In view of the great difficulty of removing the last traces of oxygen an upper limit of 0.02 per cent. was regarded as satisfactory. In the antimony-copper series, alloys containing up to 0.85 per cent. antimony have been studied, and in the arsenic-antimony-copper series, up to 0.5 per cent. of each impurity together. In the former series, alloys containing up to 0.47 per cent. antimony withstood hot rolling and up to 0.85 per cent. cold rolling from cast billets. An alloy containing 0.85 per cent. antimony was hot short. In the latter series all compositions withstood rolling either hot or cold. The investigation deals with methods of preparation and casting; rolling behaviour; density hardness; tensile properties at ordinary temperatures and at 250° C.; fatigue and impact properties; electrical conductivity; softening temperature of cold-worked material; and microstructure. The solubility of antimony in solid copper has been re-determined. Antimony is highly soluble in solid copper and small additions of this element to copper low in oxygen are found to improve the tensile strength at ordinary temperatures and at 250° C., the fatigue properties, and to raise the softening temperature (of cold-worked material), without impairing ductility or toughness. Copper low in oxygen, containing antimony and arsenic together, appears to withstand hot rolling better than with antimony alone. The mechanical properties of copper low in oxygen are improved by small additions of antimony and arsenic together, to a greater extent than by additions of either of these elements separately. The softening temperature of cold-worked material is raised.

Both these impurities lower the electrical conductivity of copper, but antimony alone appears less injurious than arsenic alone.

The rolling of Alloys of Copper and Phosphorus containing up to 5 per cent. of Phosphorus. By Owen W. Ellis, M.Sc.

Rolling experiments are described on alloys of copper with 2-6 per cent. phosphorus with and without the addition of 5, 10 or 15 per cent. manganese or nickel. The plain phosphorus-copper alloys can all be successfully hot-rolled at 450-650° C. to produce strip 0.021 in. thick provided that only small reductions of thickness are made at each stage of the rolling. In this way the copper-copper phosphide eutectic structure is thoroughly broken up and the strip can then be cold-rolled to 0.015 in. Strip, 0.018 in. thick and 1.2 in. wide, made by hot-rolling the 5 per cent. phosphorus alloy at 450° C. has a tensile strength of 88.000 lb./in. 2 and is suitable for use as a high melting point solder for the electrical industry. Addition of manganese or nickel to the alloy renders it harder and much more brittle in the hot-rolling process.

GEOLOGICAL SOCIETY OF LONDON.

Annual General Meeting.
February 20, 1931.
Prof. E. J. Garwood, M.A., Sc.D., F.R.S., President, in the chair.

The Reports of the Council and the Library Committee, proofs of which had been previously distributed, were taken as read. The Report of the Council stated that, of the 37 Fellows elected in 1930 (11 less than in 1929), 29 paid their Admission Fees before the end of that year, making, with 12 previously-elected Fellows, a total accession of 40 in the course of 1930. During the same period, the losses by death, resignation, and removal amounted to 59. The total number of Fellows at December 31, 1930, was 1254.

The completion of Vol. LXXXVI of the Quarterly Journal was announced.

The Society's Accounts for the year 1930 were presented in a different form from that hitherto adopted, a Balance Sheet and Income and Expenditure Account being substituted for the simple statement of Receipts and Expenses The total income credited to the General Purposes Account for 1930 (including amounts transferred from the Sorby and Hudleston Bequests, the Prestwich Fund, the Barlow-Jameson Fund, and the Voluntary Publication Fund) amounted to £4,590 9s.10d. The expenditure amounted to £4,404 9s. 2d. The cash at the Bank and in hand was £313 17s. 6d., and the excess of Income over Expenditure for the year was £186 0s. 8d.

The Reports and Accounts were received and adopted.

The President then handed the Wollaston Medal to Mr. H. T. Andrews, Political Secretary to the High Commissioner for SouthAfrica, for transmission to Dr. Arthnr William Rogers, and said :—

Mr. Andrews :

The Council of the Geological Society has this year awarde dthe Wollaston Medal—the highest honour which it has to bestow —to Dr. Arthur William Rogers, in recognition of the value of his contributions to the geology of South Africa.

For some eighteen years he acted, first as Assistant and later as Director of the Geological Commission of the Cape of Good Hope, and during this time was responsible for the reports published in the current volumes of the Commission.

In recognition of this earlier work he received from this Society in 1907 the award of the Bigsby Medal.

After the sudden death of Kynaston, Dr. Rogers was appointed first Acting-Director, and in 1917 Director, of the Geological Survey of the Union of South Africa. The series of valuable reports published under his direction, and the remarkable progress which has been made in mapping the geology of the country, testify to his zeal and energy.

The area of the Union is over 400,000 square miles, and is divided into 169 map sheets, of which 38 have already been published, and another 25 have been surveyed. When we rememher the small staffs available, and the difficulties of the country, together with the complicated structure in many parts and the paucity of marine fossils, it is truly astonishing that so much has been accomplished during his Directorship. Although much detailed work remains for the future, enough has already ben done to bring the general structure of the greater part of the whole area.

Mr. Andrews suitably replied.

The President then handed the Murchison Medal awarded to Dr. George Walter Tyrrell, to Prof. J. W. Gregory.

Professor Gregory replied.

Mr. President :

I very much regret that a sudden indisposition has prevented Dr. Tyrrell from being present in person to receive this Medal. He has, however, sent a suitable written message.

The Lyell Medal, awarded by Mr. Ernest Clayton Andrews, was then handed to the Hon. Sir Fuller, K.C.M.G., Agent-General for New South Wales.

The President then handed the Bigsby Medal to Sir John Flett for transmission to Mr. Norman Levi Bowen.

The Ballot for the Council and Officers was taken, and the following were declared duly elected for the ensuing year :—Council :Frederick Noel Ashcroft, M.A., F.C.S.; Prof. Percy George Hamnall Boswell, D.Sc., A.R.C.S., D.I.C.; Prof. Charles Gilbert Cullis, D.Sc.; Sir John Smith Flett, K.B.E., M.A., LL.D., D.Sc., F.R.S.L. and E.; Prof. Edmund Johnston Garwood, M.A., Sc.D., F.R.S.; Prof. Albert Gilligan, D.Sc., B.Sc.; Prof. William Thomas Gordon, M.A., D.Sc., F.R.S.E.; John Frederick Norman Green, B.A.; Prof. John Walter Gregory, LL.D., D.Sc., F.R.S.; Leonard Hawkes, D.Sc.; Charles William Hobley, C.M.G.; Prof. Owen Thomas Jones, M.A.. D.Sc., F.R.S.; Sir Albert Ernest Kitson, C.M.G., C.B.E.; Emil Montag, M.Sc.; Bernard Smith, M.A.,

Sc.D.; Walter Campbell Smith, M.C., T.D., M.A.; Leonard Frank Spath, D.Sc.; Prof. Henry Hurd Swinnerton, D.Sc.; Herbert Henry Thomas, M.A., Sc.D., F.R.S.; Cecil Edgar Tilley, Ph.D., B.Sc., A.I.C.; Prof. William Whitehead Watts, LL.D., Sc.D., M.Sc., F.R.S.; Leonard Johnston Wills, M.A., Sc.D., Ph.D.; and Sir Arthur Woodward, LL.D., F.R.S., F.L.S.

Officers:— *President*: Prof. Edmund Johnston Gardwood, M.A., Sc.D., F.R.S.; *Vice-Presidents*: John Frederick Norman Green, B.A.; Prof. John Walter Gregory, LL.D., D.Sc., F.R.S.; Herbert Henry Thomas, M.A., Sc.D., F.R.S.; and Prof. William Whitehead Watts, LL.D., Sc.D., M.Sc., F.R.S.; *Secretaries*: Walter Campbell Smith, M.C., T.D., M.A., and Prof. William Thomas Gordon, M.A., D.Sc., F.R.S.E.; *Foreign Secretary*: Sir Arthur Smith Woodward, LL.D., F.R.S., F.L.S.; and *Treasurer*: Frederick Noel Ashcroft, M.A., F.C.S.

MINERALOGICAL SOCIETY.

March 17.

Sir John S. Flett, President, in the chair.

On a new method of detecting pyro-electricity. By A. J. P. Martin.

On changing the temperature of certain crystals electric poles of opposite sign are developed at the two ends. In these experiments the temperature change is produced by cooling in liquid air and the electric charge is detected in the following way. The crystal is suspended by a long thin glass fibre near to the copper plate which may be moved near to or away from the crystal, both of them being immersed in the liquid air. The charge on the crystal induces an equal and opposite charge on the plate and the attraction between the two causes the crystal to move nearer the plate. This method is specially suited to very small crystals or to those which are decomposed on heating.

On the Mbosi meteoric iron, Tanganyika Territory. By Dr. D. R. Grantham and Frank Oates.

A wedge-shaped mass of meteoric iron measuring 10 × 4 × 3 feet and estimated to weigh 12 to 15 tons was found late in 1930 near Mbosi between Lakes Tanganyika and Nyasa. It is a medium octahedral containing 8.69 per cent. of nickel.

On the Dhoon (Isle of Man) granite: a study of contamination. By S. R. Nockolds.

The Dhoon granite forms a small boss-like mass intruded into the Lonan Flags. Two main types are present, one of which is slightly earlier in date than the other. The difference between the two types is mainly textural. The main type may be termed biotite-granodiorite-porhyry whilst the other biotite occurs in clots and in assication with zoisite, ilmenite (usually with a border of granular sphene), sphene itself and, more rarely, epidote, clinozoisite and garnet. These clots represent the last remnants of a regionally metamorphosed basic igneous rock which has been absorbed by the original granitic magma. The theoretical aspects of this contamination are discussed and it is finally concluded that the original magma was of alkali-granite type and similar to the quartz porphyry dikes which are associated with the mass. All the evidence points to an extensive interchange of oxides between the original magma and the basic igneous rock. Further it is shown that the peculiar albitization of the felspars in the "granite" of both types, is indirectly dependent on the contamination.

On clouded felspars as a result of thermal metamorphism. By A. G. MacGregor.

A special type of cloudiness in plagioclase due to the development of minute inclusions is shown to be the result of contact thermal metamorphism acting after consolidation of the igneous rock. The effects have been observed in various contact metamorphosed lavas in Scotland. Similar cloudiness is observed in the Scourie Dyke, the "hyperites" of Sweden, malchite of Melibocus, and many other rocks. The possibility of similar clouding being produced as a deuteric effect at a late stage in consolidation is considered.

On the residual liquids of crystallizing magmas. By C. N. Fenner.

Discussion of the character of the residues left by the crystallization of magmas, and consideration of articles by F. Walker, Daly and Barth, Bowen, Schairer and Williams in which some criticism has been offered of the present author's paper, on "The Crystallization of Basalts." In conclusion a short summary is given of outstanding points of evidence that should be taken into consideration in forming an opinion on the broad problems of differentiation.

NOTICES OF BOOKS.

A Textbook of Inorganic Chemistry Edited by PROF. J. NEWTON FRIEND. Vol. VII. Part II. *Sulphur, Selenium and Tellurium.* By R. H. VALLANCE, D. F. TWISS AND MISS A. R. RUSSELL. Pp. x x vii+420. London: Charles Griffin and Company, Drury Lane, W.C. 1931. Price 25s.

The eleven volumes which comprise Prof. Newton Friend's monumental *Textbook of Inorganic Chemistry* have now nearly all been published. The latest to appear is Part II of Vol. VII and it deals with the elements Sulphur, Selenium and Tellurium, together with their inorganic and not a few of their organic compounds. In accordance with the general plan of the work the occurrence, isolation, physical and chemical properties and other information is given in full detail and there are very complete lists of references to original work for those in need of more than the summarised accounts which are included in this book.

The rôle of sulphur in chemical industry needs no emphasis. The element itself and its chief compound, sulphuric acid, are being produced in ever-increasing quantities and find extremely wide applications. The chemical investigations of sulphur and its compounds have also contributed greatly to the advancement of science and it is a feature of this book that the results of these investigations, undertaken with varied objects in view, have been fully and carefully described. The same applies to the less common and more recently studied selenium and tellurium. The remarkable electrical properties of selenium have afforded a fruitful field of research for the physicist and physical chemist and applications of these reseaches are now extending in industry and in every day life.

Tellurium was the subject of close study in the later decades of last century owing to its abnormal atomic weight. At the present time its organic compounds are receiving considerable attention.

The present volume in Prof. J. Newton Friend's *Textbook* fully maintains the high standard of the series, which has been recognised as indispensable to all Inorganic chemists.

Gasanalyse in der Technik. By Dr. P. SCHUFTAN. Pp. 80. Leipzig: Verlag von *S. Hirzel. 1931. Price 5 marks 50 pf.*

The author has described (with illustrations) the modern methods of industrial gas analysis, both qualitative and quantitative and has devoted considerable attention to the sources of errors in the various determinations especially as regards the evaluation of individual gases. He has been mainly concerned with the hydrocarbon gases although the general method adopted for other industries are also given. He gives typical results for coal gases and for the gases obtained by "cracking" petroleum. Finally there is a useful appendix of the Gas constants.

We have received the Report on the circumstances attending an explosion in an acid mixing plant in Yorkshire, on July 4, 1930. By S. H. NEWMAN, B.Sc., A.I.C. and H. E. WATTS, Ph.D., F.I.C. (published by H.M. Stationery Office, price 9d.).

A Laboratory Manual of Electro-Chemistry. By Dr. ERICH MULLER. Translated from the fourth German Edition by Dr. H. J. T. ELLINGHAM. Pp. XII+363. London: *Routledge. 1931. Price 15s.*

The English Edition of this *Laboratory Manual* is intended as a companion volume to Allmand and Ellingham's *Principles of Applied Electro-Chemistry.* It affords a systematic course of practical work including the measurement of conductivity, electromotive force, the study of polarisation, the verification of the laws of electrolysis, electrolytic methods of analysis, the preparation of numerous inorganic and organic substances by electro-chemical means and other applications based upon the foregoing processes.

A very large number of the experiments described can easily be carried out in any laboratory equipped for practical physical chemistry and the book should commend itself to physical chemists as a practical handbook on electro-chemistry.

Matter and Logic. By Dr. W. TOMBROCK. Obtainable from the author at Bergen op Zoom, Holland. Price 60 cents or 1s.

The author has attempted a logical explanation of the properties of matter and cognate physical phenomena.

An ingenious exponent of the emission theory, by suitably framing his fundamental postulates, might fairly meet all the objec-

tions that have been raised against it. It will be found, however, that these necessary postulates endow the corpuscles with the periodic characteristics of a wave motion, and when this is introduced the corpuscles themselves may be eliminated, for the wave motion alone sufficiently explains the phenomena.

Emitted light electrons produce secondarily movements in the ether which simulate the results of the undulation theory—electrons cannot be eliminated for this reason.

The manifestations of gravitation and similar phenomena are to be attributed to the action of *protons*, whereby in the cyclonic motion the particles in general *lose translational* motion and *gain rotational* motion. Through this is produced a relatively increasing pressure of the surrounding particles by which protons and proton-complexes are driven in the direction of the *least resistance*.

In discussing *The Chemical Atom in the Conception of Discontinuous Matter : H, He, Li, C*, Dr. Tombrock says that the conception of discontinuous matter, which takes as it starting point : motion and collision and as object : an understandable explanation of nature, leads, on the assumption of the electron to be a material particle of larger volume, to a proton which appears as a whirl in an ether with simple atoms.

The recognised stability of the chemical atom demands an understandable connection or coupling between the protons in it. This coupling suggests itself in a common path of secondary orbits of motion set up by the protonic whirls, these secondary orbits appearing as circular whirlwinds round the primary protonic centres of motion would at the same time explain the circular or elliptical motions of the "spinning" electron.

One objection has been raised against these views, *viz.*, the absence of the mathematical treatment which is so characteristic in physics nowadays. To their defence it may be that in this case logic must lead the way, logic going fairly well without mathematics here, whereas applied mathematics without logic is simply nonsense. Moreover chemistry, particularly organic chemistry, has obtained its end all right without mathematics in the finer sense of the word and is now considered by many scientists as the most exact branch of human knowledge.

Forthcoming Events.

PRAGUE SUMMER SCHOOL.

July 20—August 8, at the Prague Summer School, during the long vacation there will be delivered lectures in English in a number of subjects including Literature, Art and Science in Czechoslovakia, the History and Geography of Central Europe, and there will also be language courses in German, Czechoslovak and Russian.

Particulars of the fees for one, two or three weeks, reduced railway fares and other facilities and excursions in connection with the course may be obtained from Dr. B. Trnka, 55, Smetana Square, Prague, Czechoslovakia.

MOTOR EXHIBITIONS.

The Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London, S.W.1 are organising two Motor Exhibitions, which will be held at Olympia, Kensington, London.

These Exhibitions are :

The International Motor Exhibition, October 15-24 (for Private Cars, Carriage Works, Motor Boats, Tyres, Accessories and components and Service and Garage Equipment).

The International Commercial Motor Transport Exhibition, November 5-15. (For Vehicles for Goods and Passenger Transport and general utility purposes; Bodywork, Trailers, Components, Accessories and Tyres; Service and Garage Equipment.)

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

7,291.—Chemische Fabrik vorm. Sandoz. —Prepartiaon of 1-aminoanthraquinone-2-sulphonic acid. March 9.

7,949.—Chemische Fabrik vorm. Sandoz. Metalliferous sulphurized phenol derivatives. March 14.

7,552.—Chemische Werke vorm. H. and E. Albert.—Production of alumina and alkali phosphates. March 11.

Specifications Published.

344,482.—Berl, Dr. E.—Manufacture of *acetic anhydride.*

344,627.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of alkylated 3 :6-di-amino-acridinium-compounds.

344,761.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of *cellulose nitro-acetates.*

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

MULTIFEX.

519,431.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives, but not including dye-stuffs and chemical liquids for reducing the effects of sulphation in accumulators and not including any goods of a like kind to any of these excluded good.—Glazebrooks, Ltd., Tyseley Pain and Varnish Works, James Road, Tyseley, Birmingham. March 18.

DEKIT.

519,434.—All goods in class 1 which includes chemical substances used in manufactures, philosophical research, and anti-corrosives, but not including photographic chemicals, sensitized plates and sensitized films for photography and not including any goods of a like kind to these excluded goods.—Glazebrooks, Ltd., Tyseley Paint and Varnish Works, James Road, Tyseley, Birmingham. March 18.

ATRAM.

519,393.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives, but not including aniline dyes and not including any goods of a like kind to aniline dyes. —L. G. Farbenindustrie Aktiengesellschaft, Gruneburgplatz, Frankfurt-on-the-Main, Germany. March 18.

GRAMMAR OF LOGIC.

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A list of various Important Scientific Books for Sale at usually ***less than half published prices*** *will be sent on application to the Manager, Chemical News, Merton House, Salisbury Square, London, E.C.4.*

FILTERS FOR THE REPRODUCTION OF SUNLIGHT AND DAYLIGHT AND THE DETERMINATION OF COLOUR TEMPERATURE.

By RAYMOND DAVIS AND K. S. GIBSON.
(U.S. Bureau of Standards.)

A large number of filters have been developed for use in photographic sensitometry, colorimetry, and photometry. They are reproducible from specification and may be prepared in the laboratory. They consist of a 2-compartment cell with three borosilicate crown glass windows, the two compartmtnts being filled, respectively, with solutions A and B, having compositions as follows :

Solution A

Copper sulphate ($CuSO_4.5H_2O$)	*g*	*c*
Mannite ($C_6H_8(OH)_6$)	*g*	*c*
Pyridine (C_5H_5N)	*cc*	30.0
Water (distilled) to make	*cc*	1,000

Solution B

Copper sulphate ($CuSO_4.5H_2O$)	*g*	c_1
Cobalt ammonium sulphate ($CoSO_4.(NH_4)_2SO_4.6H_2O$)	*g*	c_2
Sulphuric acid (sp. gr. 1.835)	*cc*	10.0
Water (distilled) to make	*cc*	1,000

The values of c, c_1, and c_2 vary from one filter to another.

The design of the filters has been based upon extensive spectrophotometric measurements of the component solutions and cell, including a study of Beer's law over the ranges of concentrations used, and upon methods of computation giving accurate colour matches and relatively good spectral energy matches between the source-and-filter combination and the energy distribution which it was sought to duplicate. Detailed studies have been made of the reliability of the data, the spectrophotometric reproducibility of the chemicals, the permanence of the solutions, their temperature coefficients, and various other factors of importance in the preparation and use of the filters.

The paper contains 33 figures and 26 tables, giving among other things the energy distributions and fundamental spectrophotometric and colorimetric data used in the computations, auxiliary spectrophotometric and colorimetric information obtained during the investigation, and the trilinear co-ordinates of the various source-and filter combinations and of the Planckian radiator from 1,600° to 20,000° K. computed on the basis of the adopted mean sun as the " neutral " stimulus. The filters are further described in 38 charts, each chart giving the chemical formula, the spec-

tral transmission, and the light transmission of the filter, as well as the spectral energy distribution of the source, that of the source and filter combined, and the energy distribution which serves as the ideal in that particular case.

SOME RECENT ADVANCED WORK IN PHYSICS.

In the *Reviews of Modern Physics*, January, 1931, vol. 3, A. Sommerfeld of 'atomic structure' fame and Dr. N. H. Frank contribute a long article of 42 pages. The introduction to this report will suffice to indicate its scope. Thermoelectricity and the galvano- and thermo-magnetic effects in metals have been investigated theoretically and experimentally, to a great extent during the past half century; but in spite of the enormous amount of work done in these fields a satisfactory explanation of these phenomena has been lacking until within a few years. The electron theory of metals, particularly as developed by Lorentz, has been given a new lease of life by the application of the Fermi-Dirac statistics. The main theme of this report will be a more or less detailed development of the newer electron theory in its application to the above-mentioned subjects. Dr. K. K. Darrow has contributed an article, "Statistical Theories of Matter, Radiation and Electricity," that has already appeared in this journal, so that the present authors will avoid repetition of Dr. Darrow's presentation to an unnecessary extent.

In the same journal E. U. Condon and P. M. Morse (appendix) contribute a long article on quantum mechanics of collision processes, the sub-headings being :— Laws of Quantum Mechanics; One-dimensional Collisions; Special One-dimensional Collisions; Three-dimensional Collisions; Scattering in a Coulomb Field; Non-stationary States—Wave-packet Methods; Appendix (by Morse) — Scattering by a Crystal Lattice.

Robert S. Mulliken contributes an extensive report on the Interpretation of Band Spectra (Part IIc)—Empirical Band Types. And finally H. A. Wilson reports on the Electrical Conductivity of Flames—mainly Bunsen gas flames. The conductivity of the Bunsen flame containing alkali-metal salts and other conditions are dealt with. Mention may be made that the Hall effect in flames is treated at some length.

F. H. L.

USE OF NICKEL IN CHEMICAL PLANT.

The uses of nickel in chemical plant are wide and varied. Nickel ,apart from being used itself, enters into a large number of alloys ,practically all of which may be used for some part or other in chemical plant. In this article, however, it is proposed to deal only with pure nickel and to indicate some of the applications for which it is now being extensively employed. An account of the uses of some of its alloys will be given in subsequent articles.

In order that a metal or alloy may be suited for use in any particular plant part it must possess certain physical and mechanical properties under the conditions of service to which it will be exposed. It must be available in all forms in which it may be required, and should be readily workable. This is necessary not only in the setting up of the original plant but also, and perhaps to a greater extent, in connection with any repairs which may subsequently be required.

Regarding the physical and mechanical properties, the most important of these is the resistance of the metal or alloy to corrosion by the reagent to be handled, under the particular conditions to be imposed. This is placed before strength, as no matter how strong a material is if it is readily attacked then its life will be short. In considering corrosion resistance in connection with choice of materials there are many variables which have to be taken into account. It has been stated that as many as fourteen variable may be involved in any one corrosion problem. When we consider that a slight alteration in one of these variables may lead to the breakdown of a metal or alloy in one plant, although the same material may have stood up indefinitely in another plant where the alteration has not been made, we realise the importance of attention to detail when deciding on the materials to be employed for any particular service. It cannot be too strongly emphasised that *all* the conditions must be accurately known before even a suggestion can be made as to a suitable material to be tried; indeed, the only real test of any metal alloy is to build a complete unit in it and to run this unit for an extended period. In actnal practice, of course, this test is only applied when there are very strong indications of success. In the majority of cases the suitability or un-

suitability of any one material must be judged from laboratory experiments arranged to reproduce as closely as possible plant conditions.

The above remarks have referred chiefly to the resistance of a material to corrosion as affecting its useful life. There is, however, another side to the corrosion question, namely, the effect of solution of a metal alloy on the purity or colour of the substance being handled. In particular this applies to food-handling plants where questions of toxicity or non-toxicity of metals and their salts must also be considered. Some further reference will be made to this when dealing with the applications of nickel where these factors are involved.

The second most important property to be considered is that of strength. By strength in this instance is included not only the tensile or compressive strengths but also the resistance of the metal to fatigue and particularly to shock. Nowadays in many chemical operations it is necessary to consider both the mechanical properties at ordinary temperatures and also those at temperatures much above the normal.

There are, of course ,other factors, such as expansion, heat-transfer, etc., which cannot be overlooked, but the above a e those of outstanding importance.

That nickel is emineutly suited for plant parts in chemical engineering will be evident from the following brief summary of its properties.

THE PROPERTIES OF NICKEL.

Nickel, as is well known, is a white metal which does not readily tarnish in the air at ordinary temperatures. It dissolves only slowly in hydrochloric acid and sulphuric acid but is readily soluble in nitric acid. Its resistance to alkalies is an outstanding feature. It is insoluble in solutions of caustic soda and caustic potash and is unaffected by the fused alkalies except under certain special conditions.

It is completely resistant to, or but slowly attacked by, a large variety of the weaker acids, and is also unaffected by a large number of neutral salts.

The rate of attack of any metal is often dependent to some extent on its purity. Malleahle nickel, though slightly less pure than raw nickel, is now produced in all the usual forms with a nickel content which is generally 99.5 per cent. and over. In Table No. I is given a typical analysis of malleable nickel as supplied to-day.

TABLE I.

TYPICAL ANALYSIS OF MALLEABLE NICKEL.

Nickel	99.62 per cent.
Copper ...	0.04 ,, ,,
Iron	0.15 ,, ,,
Manganese ...	Nil
Magnesium ...	0.12 ,, ,,
Silicon	0.02 ,, ,,
Carbon	0.05 ,, ,,
	100.00

As regards mechanical properties, nickel has a tensile strength comparable to that of mild steel, and excellent resistance to shock and to fatigue stresses. It is one of the strongest of the non-ferrous metals.

In the malleable form nickel has all the properties such as machinability and workability, necessary for constructional parts. In connection with the construction of such parts as pans, it is frequently essential that joints should be made by welding to ensure that the joint has as good resistance to corrosion as the remainder of the pan. This can readily be done in the case of nickel by any of the well-known welding methods generally employed. Some idea of the strength of nickel welds may be obtained from the results which have been published by Pilling and Kihlgren. Their tests were carried out on standard welded specimens made by butt welding the 7.6 cm. (3-inch) sides of 7.6 by 15.2 (3 by 6 inch) specimens 3.2 mm (0.125 inch) thick and then milling off the edges to leave a section 5.1 cm. (2 inches) wide and about 12.7 cm. (5 inches) long. The results are summarised in Table II.

TABLE II.

Method	Tensile Strength of Nickel Welds *Tons per sq. in.*	Elongation per cent. *on 2 inches*
Metallic arc ...	33 ...	32.1
Carbon Arc ...	30 ...	30.0
Oxy-acetylene ...	32 ...	34.5

SOME TYPICAL APPLICATIONS.

Bearing in mind the above remarks regarding properties, a few of the more important applications for which nickel is bein gemployed will now be summarised, and some indication given of the particular property or set of properties which has led to its adoption.

Alkalies.—In the manufacture and handling of alkalies such as caustic soda it is essential that there be no contamination of the product by harmful impurities resulting for instance, through contact with the materials from which the plant parts are constructed. As already indicated, nickel successfully resists all attack by alkalies. This has been established both by laboratory investigations and by service trials. In fact, caustic soda which has been concentrated in pure nickel evaporators can be produced with a nickel content which is, at most, considerably less than two parts in ten millions. It is, therefore, not surprising to find nickel widely used in connection with the handling and manufacture of alkalies.

Apart from resistance to corrosive action, in this particular application resistance to abrasion is also a factor of importance. In caustic soda evaporators there is considerable abrasive action on the evaporator tubes. To resist this, nickel tubes are used in the hard-drawn condition, with only a subsequent low-temperature treatment which does not affect their resistance to abrasion but is sufficient to relieve drawing stresses. In cases where nickel tubes are usd it is general also to employ nickel for the tube plates. This is advisable, as when cast iron or steel tube plates are used in conjunction with nickel tubes, some galvanic corrosion may occur. In the case of nickel, tube plates can be made so rigid and durable that they can be used appreciably lighter in section than rolled steel or cast iron. Tube plates only ½ in. thick have been used successfully.

To illustrate this application mention may be made of the construction of four 24-ft diameter evaporators for the concentration of caustic soda. In addition, two 10-ft diameter units operate at 200 lbs. steam pressure in the heating elements in this plant. More than 250,000 lbs. of pure nickel in the form of tube plates, down-take sheets, expansion joints, tubes, bolts, nuts and rivets, were employed on this job, the largest caustic soda evaporators ever built.

Another illustration is that of an ebullition chamber, which weighs 4½ tons, is built up from ¼ in. thick pure nickel sheet by welding, as are also the pipe branches. The clamping rings and bolts are in mild steel. This vessel works under a vacuum of 27 in. at a temperature of 126° C. and has a capacity of 1,660 gallons per minute. Considerations of purity have also led to nickel expansion pieces of the bellows type being fitted into 12-in. and 18-in. pipe lines on the same plant.

Apart from its use in the manufacture of caustic soda, nickel is employed in many plants where alkalies have to be handled at some stage of the process. For instance, in the sulphate process of paper making, caustic soda is reclaimed from the so-called "Black Liquor," which is highly alkaline, and contains considerable quantities of sulphides. Here nickel evaporator tubes are used. Similarly, in the production of cellulose acetate artificial silk, nickel tubes are used for transferring the alkaline mixture from the source of supply to the spinnerettes through which it is exuded.

A further typical application of nickel in contact with alkalies is a group of nickel converter bodies used in the ammonia oxidation process for the fixation of atmospheric nitrogen. In this particular instance resistance to attack by ammonia was the decidin gfactor in employing nickel.

Acids.—Of the inorganic acids, hydrochloric is one of the most difficult to deal with in plants, as all metals, except precious metals, are attacked by it to a greater or lesser degree. Nickel, although slowly attacked, has been found to be the most resistant of the common metals or alloys at present available. This has led to its use, for example, in plant for the purification and reclamation of carbon tetrachloride, which compound on hydrolysis forms hydrochloric acid. Similarly nickel is being employed for mixing chambers for the mixing of patent dry cleaners containing carbon tetrachloride, and for the containers in fire extinguisher parts where this substance is employed.

Another typical example of its use in contact with hydrochloric acid is for the retorts and reaction chambers used in the commercial preparation of aniline hydrochloride. Mention might also be made here of its use in contact with chlorine gas, as, for instance, in control devices in water purification systems.

Hydrofluoric acid also gives rise to considerable difficulties in plant parts which must be used in contact with it, and here again nickel is proving helpful. For instance, it is being used in connection with the manufacture of electric bulbs for parts of lamp-etching machines in which hydrofluoric acid is the etching medium.

Organic acids are present in a considerable proportion of the applications for

which nickel is used, but as many of these applications come under the category of foodstuffs, they will be referred to later. In this section only one or two typical examples of the use of nickel in contact with organic acids will be given.

Acetic acid is probably the best known and incidentally one of the most troublesome of the organic acids. It is used in many chemical operations and in a number of cases plant parts which come in contact with it are constructed in nickel. An instance of this is to be found in the manufacture of cellulose acetate film and related products. In their production cotton linters are used as raw material, and these receive a preliminary washing treatment with acetic acid or acetic anhydride. Nickel is employed for such parts as perforated baffle plates, agitators and linings in washing tanks which come in contact with the washing medium.

Applications of nickel where purity of product is the outstanding feature occur in the handling of cresylic acid. In the manufacture of soaps containing this acid it is frequently necessary to have the acid pure enough to be substantially odourless. This has been obtained by carrying out the purification of the acid in stills, containers and related equipment constructed in pure nickel.

Other organic acids which are being handled in nickel equipment include citric, tartaric, carbolic and stearic acids.

Neutral Substances.—There are many other applications where purity of product is essential. Generally speaking, a high degree of purity is needed in most of the cases where neutral substances are being handlel as, for instance, in the preparation of pharmaceuticals. In this field nickel crystallisers, tanks and centrifuges are being used for handling such substances as potassium iodide, milk of magnesia and perfumes. Pure nickel storage tanks up to 1,000 gallons capacity are used for perfume, bay-rum and other similar extracts.

Again, in the preparation of photographic gelatine, nickel has been employed for tubes and evaporators because of its non-fogging properties. Most metals, including copper and tin, cause fogging of photographic emulsion and are, therefore, to be avoided in photographic gelatine.

In the case of synthetic resins these are often required of a clear light colour and high melting point. In their preparation nickel is being used for jacketted pressure kettles fitted with agitators and heated with oil. For this application nickel has replaced other metals because of its greater strength, equal or better corrosion resistance, and because of the fact that it does not affect the colour of the resins.

Some further typical examples include its use for jacketted kettles, tanks and agitators in the production of cosmetics, for valves and tubing in the refining of common salt and for the handling of cream of tartar used in the manufacture of baking powders.

FOODSTUFFS.

Within recent years nickel has been widely used in the processing and handling of foodstuffs. Its rather unique combination of good mechanical properties and resistance to corrosion by the organic and inorganic substances found in foods make it admirably suited for such purposes. There is, however, another factor of outstanding importance to which brief reference has already been made under the heading of corrosion, namely, non-toxicity. This property is of particular note in connection with deciding on metals suitable for use in contact with foodstuffs. Many investigators have made a study of the toxicity of metals which might possibly be employed and there is unanimous agreement in published results *that nickel is absolutely non-toxic.* It can, therefore, be employed with entire safety.

Of all the food industries there is probably none which demands a greater degree of purity of product, and therefore absolute cleanliness of plant, than does the dairy industry, in which considerable quantities of nickel are used. The ease with which nickel may be kept clean and sterile is one of its great advantages in this connection. It possesses a smooth surface little agected by alkaline scouring or disinfecting agents which not only maintain sterility but help to preserve its attractive appearance. Unlike copper, nickel has a negligible catalytic action in the form of its salts on the rancidification of milk fats and it therefore does not impart the metallic or lardy flavour noticeable in milk which has been treated in copper vessels. It is being employed in various forms for storage truck tanks and vat linings, milk and cream pasteurisers and other dairy equipment.

For similar reasons to the above nickel is also used in a wide variety of other food handling equipment. In the preparation of preserves, sauces and pickles it finds useful application in the form of steam jacketted boiling pans. The fact that joints in this metal may readily be made by welding is of

some importance in the construction of these pans, while its resistance to attack by steam is also of considerable value.

Further applications include the use of nickel in breweries for beer storage tanks and coils. In the handling of fruit juices in the fruit canning, concentration and dispensing industries, evaporators, driers, coils, tanks and dispensing equipment are made from nickel.

UTILISATION OF BLAST FURNACE SLAG IN JAPAN.

According to Mr. Kaharu (engineer of the Japanese Government Steel Works), the annual production of the blast furnace slag in Japan is steadily increasing, as shown in Table I :—

TABLE I.

THE PRODUCTION OF BLAST-FURNACE SLAG IN JAPAN.

Year	Production Tons	Year	Production Tons
1925 ...	598,000	1927 ...	945,100
1926 ...	753,700	1928 ...	1,047,600
1929 ...	1,148,800		

Therefore, how to utilise the slag has become a serious problem for the iron industry of this country.

As the kinds of products made from the blast furnace slap now in market, the following may be mentioned, namely, slag mortar, slag brick, blast furnace slag cement, iron Portland cement, material for Portland cement manufacture, slag ballast, slag tar ballast, asphalt tar block, cast slag block and slag wool.

Slag cement and slag mortar made by mixing the slag with about 10 per cent. of slaked lime are not very promising products, because a rather special sort of slag having such chemical composition and high hydraulic index as just fit for the purpose are needed, and even then the products are not so good as the usual Portland cement or the mortar made therefrom. Their annual production in this country is estimated to be about 2,000 metric tons in the form of slag mortar. They are made only for the home uses of the iron works themselves and not put on the market.

Slag bricks made by letting the slag mortar sit in a suitable mould are used more frequently than the slag mortar direct, because slag of rather inferior quality can safely be used for this purpose and the products are satisfactory. Their annual production is increasing for the past 5 years, as shown in Table II. But it seems now to have reached the saturation limit of the market, and the further increase can hardly be expected.

TABLE II.

AMOUNT OF SLAG-BRICK MADE IN JAPAN.

Year		Amount
1925	...	44,000,000 pieces
1926	...	27,000,000 ,,
1927	...	28,700,000 ,,
1928	...	49,500,000 ,,
1929	...	61,000,000 ,,

Blast furnace slag cement and iron Portcement made by mixing powdered slag with ordinary Portland cement are used much and is perhaps the most promising method of utilization of the slag, because the products are good and less expensive. The annual production in this country is rapidly increasing as shown in the Table III. The slag may also be used as a material for the Portland cement manufacture in place of clay and limestone. But in this country no cement is perhaps manufactured from this material.

TABLE III.

THE PRODUCTION OF BLAST-FURNACE-CEMENT IN JAPAN.

Year	Production Tons	Year	Production Tons
1925 ...	17,100	1927 ...	27,500
1926 ...	24,350	1928 ...	78,550
1929 ...	100,800		

TABLE IV.

THE PRODUCTION OF SLAG-BALLAST IN JAPAN

Year	Quantity Tons	Year	Quantity Tons
1925 ...	48,000	1927 ...	48,000
1926 ...	55,900	1928 ...	92,400
1929 ...	118,600		

The slag ballast making by crushing and shieving the solidified slag is the oldest, simplest and largest consumer of slag. Their annual production in this country is rapidly increasing as shown in the Table IV.

Slag tar ballasts made by impregnating the slag ballasts with coal tar pitch are used as a convenient pavement material. In this country, their manufacture began in 1928, and is expected to become the largest consumer of slag in future.

The slag blocks in this country are now in the state of trial. Slag wool made by blowing molten slag with compressed air is made in a small amount, but is a profitable product. Its annual production in 1929 is estimated to be 850 tons.

COMBINED STEAM POWER AND HEATING.

A Notable Pass-out Turbine Installation.

(By a Well Known Engineer).

More or less it is now generally recognised that in all industrial establishments requiring a considerable amount of low pressure heating and " boiling " steam, the most efficient method is to supply the latter, at any desired pressure, as the exhaust from a back-pressure or pass-out engine or turbine used for generating power.

The chemical industries are one of the most important fields in this conection, and the economy obtained is of an important character as compared with the ordinary method of compound condensing main engine drives and steam for boiling and general process work taken direct from the boilers, either separate low pressure units or through a reducing valve. Approximately the amount of the saving obtained by using a combined steam and power plant of this character is 25-50 per cent. of the coal bill, dependent on the proportion of process dteam required, which in many chemical works may be say 50-75 per cent. of the total steam production.

Typical of what can be accomplished in this connection is a " Belliss " 750 K.W. impulse pass-out turbine and generator running at 4,500 revolutions per minute, recently installed at the well-known carpet factories of Messrs. Brinton, Ltd., Kidderminster, with conditions very similar as regards steam to that of the chemical industry. This is operated with superheated steam, from already existing boilers, at about 140 lbs. pressure and 400° F. at the turbine stop valve, and to suit the particular conditions two separate pass-outs are operating. One of these supplies 17,000 lbs. of steam per hour at 30 lbs. per hour at 30 lbs. per square inch pressure for the dye-house, the other 10,000 lbs. pressure per hour at 3 lbs. pressure for heating the mill, while if necessary any additional amount of steam is available for the dye-house direct from the boilers through reducing valves, the rest of the steam going to the condenser at 28½ in. vacuum. Also four steam meters are installed, giving a continuous record respectively of the high pressure steam going to the turbine, the pass-out to the dye-house, the pass-out to the heating sytem, and any additional live steam to the dye-house direct. Further on the most economical lines the exhaust from the boiler feed pump and stand-by main engine are conected to the 3 lbs. pressure heating main.

It should be emphasised that in this connection one of the most important points of combined power and heating is to install the correct plant for the particular requirements, and Belliss and Morcom, Ltd., of Birmingham, with a practical experience represented by nearly 1,500 plants, are well lable to deal with such matters on the most scientific lines.

The electrical generator at Kidderminster runs at 750 revolutions per minute through gearing, of the totally enclosed type, while the steam generation plant consists of seven " Lancashire " boilers with economisers, 140 lbs. pressure, four with superheaters giving 470° F. as delivered obtained by mixing with the saturated steam from the other boilers. The results obtained are excellent, and as compared with the previous method of compound condensing main engines and low pressure heating steam used direct from the boilers, the saving is about 2,000 tons of coal per annum, corresponding to £2,000 per annum, the coal averaging about 20s. 0d. per ton, sufficient to pay for the whole plant in four or five years. As compared with the previous year the reduction in the coal consumption is 25 tons per week, but there has been a considerable increase in the demand for process steam, which brings the saving to 41 tons of coals saved per week.

MERCHANDISE MARKS ACT, 1926.

New Order-in-Council.

With reference to the notice issued on the 22 January, the Board of Trade announce that a new Order-in-Council under the Merchandise Marks Act, 1926, entitled the Merchandise Marks (Imported Goods) No. 7 Order, 1931, was made on the 20 March, 1931. The Order ,which requires imported fertilisers and feeding stuffs of the descriptions specified therein to bear an indication of the origin on importation into, and sale and exposure for sale in, the United Kingdom, comes into force on the 20 June, 1931. The text of the Order in draft form was published in the Board of Trade Journal of the 22 January, 1931.

The Order-in-Council as made is being published, and copies will be purchasable in due course either directly from the Stationery Office ,or through any bookseller.

Board of Trade,

25 March, 1931.

Montreal for the years 1873-1925 shows a similar effect. Many stations have been examined, and the evidence points to the widespread influence of sunspots.

Records of living things are scarce; however, old trees exhibiting variation in the record of living conditions, in many places for centuries. With the co-operation of various branches of the Dominion Government service and of others, tree sections have been secured by the Observatory from many parts of Canada. The eleven-year sunspot cycle seems to be revealed in the trees already measured, but with variations in different reions. A section of a butternut which grew at the Dominions Experimental Farm, Ottawa, exhibits a 58 per cent. range in the growth rings for the average sunspot sycle. Spruces, ineludiug two pre-glacier specimens of Sitka spruce usually show nearly a 20 per cent. range during the eleven-year cycle.

Weather fluetuations are serious faetors in living conditions, and it is not surprising that they are reflected in such records as are available of fur-bearing animals, grouse, grasshoppers, etc. In general, rabbits are most numerous about the sunspot minimum and scarce at maximum, and with this variation the animals which prey on the rabbit must also vary, in addition to direct changes resulting from the climatic pulsations. A record kept in Manitoba, when analyzed in relation to the eleven-year sunspot cycle shows striking cor-relation. Individually and combined, the records exhibit the sunspot cycle, grasshoppers at a maximum at the minimum of spots, grouse at a maximum about a year after.

Astronomers feel that fuller knowledge of the sunspot cycle will eventually assist in permitting long-range weather forecasts of a general nature, and will thus provide valuable information in relation to forest protection, wild life conservation, and other matters of social and economic importance.

SCRAP IRON AND STEEL FROM FRANCE.

Certain alterations have been made in the arrangements for the allocation among British importers of the quantity of scrap iron and steel allowed to be exported from France to this country.

GENERAL NOTES

THIRTEENTH EXPOSITION OF AMERICAN CHEMICAL INDUSTRIES.

The Thirteenth Exposition of Chemical Industries will be held at the Grand Central Palace in New York City during the week May 4 to 9, 1931.

Every second year this exposition regularly draws exhibits not only from all the forty-odd industries classified as chemical, but also from many others which produce material or equipment used in the chemical industries. No better opportunity is given anywhere else in the world for studying the latest designs in a vast array of equipment, and for comparing competitive products side by side.

It is a natural result that the exposition draws thousands of interested visitors from many industries—plant executive, chemists, engineers and officers of great corporations beside the students who come from many colleges and universities to attend the course in industrial chemistry that has become so important a part of the exposition.

The solution to many a knotty problem in plant practise has been picked up by an executive harassed by some unsatisfactory step in his manufacturing processes, for here is shown all of the latest equipment for chemical processes as well as the raw materials an dprocess chemicals.

It may be a trite statement to say that industry as we know it today could not exist if it had only the plant equipment of twenty-five years ago; but it is a fact that is worth recalling now and then. One of the great problems of chemical manufacture in which enormous strides have been made in that time is in the handling of corrosive chemicals without undue damage to the equipment; or in other words, without undue replacement costs. Equipment made of numbers of corrosive resistant materials will be shown at the coming Exposition.

In laboratory work, glass has always been a favourite material for handling chemicals, but disadvantages too well known to require enumeration have kept it out of the field of large industrial equipment. Developments of recent years by one well-known glass manufacturer, however, have resulted in a glass of such low coefficient of expansion, and such tough-

ness, that it is finding its way into many large scale chemical installations. The exhibit to be shown by this manufacturer will feature a working model of an all- glass fractionating tower and will be 8 feet high and 12 inches in diameter. All parts coming into contact with the gas or the liquid will be made of glass, while the connections will be of the Company's new type of flanged glass pipe. In connection with the fractionating tower there will also be a model tubular condenser of the type employing a nest of tubes within a cylindrical shell. Besides the industrial equipment to be included in this exhibit, the latest developments in glass laboratory apparatus also will be displayed.

The chemical manufacturer with difficult problems of corrosion to solve will find at the Exposition a wide range of corrosion-resistive equipment besides that made of glass, and will therefore be able to make a study and comparison of relative merits on the spot. Pure molded silica and high developed alloys that resist a long list of chemicals at high temperatures anr pressures no win common use are other materials that will be well represented at the Exposition.

Among the alloy equipment will be a new, self-priming pump designed especially to handle acids by taking suction over the top of tanks, or pumping from sumps and other conditions where it is necessary to place the pump over the source of supply. This pump has never before been shown at an exhibit. Other items in the same booth will be exhaust fans, valves, flanged pipe and fittings and drain pipe fittings—all non-corrosive and designed for handling acid, alkaline or other corrosive solutions.

The processes of spray-drying, as employed in a great variety of industries, have a set of problems all their own. Notably in some of the food industries, and in the manufacture of glue and gelatine, fertilizers, rubber products and sugar manufacture and refining, besides a long list of chemical industries, spray drying is used at one stage or another. One exhibitor states that at the coming Exposition he will show recently-developed spray drying equipment, which, due to a new process and new designs is said to have some marked advantages over former designs. Initial and operating costs are low; and an unusual feature is the adaptability to small, inexpensive initial installations, with expansion as desired. Another feature of the equipment is the fact that it drys the product asrapidly as it is produced—a fact that is likely to have a vital bearing on the successful handling of delicate materials. This exhibit will include a motor-driven atomizer, motor generator set and switchboard and a new scrub tower or pre-concentrator.

THE BRITISH CHEMICAL MARKET.

There was little change in the general tone of the British chemical market during February. The usual tendency to do business at less than quoted rates was particularly noticeable in the heavy chemical section. Acetone has been a very keen market and business in this item has been quite good. In spite of limited enquiry for arsenic the market remains firm, largely due to the shortage of supplies. Distillers continue to limit the production of coal tar products, and although stocks in this section are still very high, they are not accumulating at the same rate as hitherto. Creosote has remained one of the most satisfactory items on this market, stocks being fairly low and business brisk. There has also been a certain revival of interests in refined coal tar, and several good contracts were place dearly in March.

The pharmaceutical market has been rather more satisfactory than the heavy chemical section, and although orders have not been large they have been decidedly more numerous. Signs of improvement in critic and tartaric acids and cream of tartar are still lacking, and citric acid prices have been dropped by ¼d. a pound. The demand for essential oils is rather more satisfactory.

MERCHANDISE MARKS ACT, 1926.

ENQUIRIES.

The following is a brief list of the classes and descriptions of imported goods in regard to which Enquiries will be held later :

(1) Lattice reinforcements and stirrups of iron and steel for concrete construction.

(2) Toys; games (other than sports requisites).

(3) Slider fasteners.

(4) Adhesive insulating tape for electrical purposes.

Any communication on the subject of these Enquiries should be addressed to Mr. E. W. Reardon, at the Board of Trade Offices, Great George Street, London, S.W.1

NEW DEVELOPMENT IN PAINT MANUFACTURE.

Improved Durability and Appearance.

As the result of many years research, a synthetic resin finish has been produced which shows proof of greater durability and higher gloss than any existing stoving enamel or other oil finish.

Indeed this new finish, known as "Dulux" and made by Nobel Chemical Finishes, Ltd., who are a subsidiary company of *Imperial Chemical Industries, Ltd.*, is claimed to be the greatest enamelling or painting since the introduction of cellulose finishes.

Of the two components of any finishing material—pigment and vehicle—it is the vehicle, *i.e.*, the oil or gum, that is the first to break down, so that the manufacturers of "Dulux" have concentrated on the evolution of an entirely new vehicle. "Dulux" vehicles hold the pigment in place with disintegration for a very much longer time than any existing oils, gums and resins. They are distinct chemical compounds, the result of scientific chemical processes, and they can be manipulated to meet application and durability requirements for almost any purpose.

Two Vehicles.

There are two types of "Dulux" vehicle, oil and gum, which dry faster than natural oils, and show greater flexibility. The oil vehicles are used for paints and the gum for enamels, and both form the basis of finishes of outstanding durability, which retain their gloss and colour longer than existing materials. An unique quality of the film obtained with the "Dulux" Finish is that it resembles ivory more closely in feel and hardness than any other material at present known. This finish is particularly suitable for use where fast-drying, greater hardness and an enamel-like appearance are required, where as "Dulux" oil finish is used in place of linseed oil or Chinawood oil paints for house decoration.

Rigorous tests in busy industrial districts, on the sea coast, and under tropical conditions have proved that these finishes show unusual elasticity and flexibility, which means that they are weather resisting, that the ari-drying types are surface dry in about 4-6 hours, and that the stoving types stove at unusually low temperature for a short time. They resist the action of heat, alcohol, petrol and oils, are extremely resistant to the action of soap and washing compounds, which so seriously affect the gloss and texture of all oil paints and are less liable to spot and smudge than existing oil finishes. They are obtainable for application by spraying, brushing or dipping. In fact these finishes appear to be the final step forward in the manufacture of paints from synthetic resins.

Manifold Uses.

It is difficult to see a limit to the uses to which "Dulux" Finishes can be put, but but the most obvious applications in the industrial field are to structural steel bridges, railway equipment signs, machinery, automatic machines, refrigerators, scales, gas and electric fires, art metal work of all kind, washing machines, wringers, office filing cabinets, etc. The air-drying "Dulux" Finishes for application by brush or spray are obviously suited to decoration, both interior and exterior, of *cinemas, public buildings and private* houses.

SPAIN.

Appointment of Agents and Methods of Trading.

A confidential memorandum regarding the appointment of agents and the best methods to be adopted in trading with Spain compiled from information furnished by the Commercial Secretary to His Majesty's Embassy at Madrid has been issued by the Department of Overseas Trade to firms whose names are on its Special Register. British firms who desire to obtain a copy of the memorandum and particulars of the Special Register service should apply to the Department. (Reference No. C.X. 3469 should be quoted.)

ROUMANIA.

Methods of Quoting and Terms of Payment.

A confidential memorandum on the subject of methods of quoting and terms of payment customary in relation to business in Roumania prepared by the Commercial Secretary to His Majesty's Legation at Buckarest has been received in the Department of Overseas Trade and issued to firms whose names are on its Special Register.

British firms desirous of receiving a copy of this report together with particulars of the Special Register service of information should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference C.X. 3476 should be quoted.

Proceedings and Notices of Societies

THE GEOLOGICAL SOCIETY.

March 18, 1931.

Prof. E. J. Garwood, M.A., Sc.D., F.R.S., President, in the Chair.

The following papers were read :—

On the Septal Development and the Genotype of the Coral Genus Petraia *Münster.* By PROF. OTTO H. SCHINDEWOLF, Ph.D. (Communicated by Dr. W. D. Lang, M.A., F.R.S., F.G.S.)

There is no coral genus which has been so persistently misinterpreted as *Petraia.* It was founded by Münster in 1839 upon small simple corals from the *Orthoceratites*-limestone of Elbersreuth and the *Clymenia*-limestone of Schubelhammer in the Frankenwald (Bavaria), on the supposition that they were gastropods.

The confusion is partly due to Münster's very meagre description and inadequate figures, but also to the fact that he, and all later writers who have described these Bavarian corals, failed to discriminate between the Elbersreuth and Schubelhammer limestones, which, as the Author has previously shown, are of different ages. The former is Upper Silurian (Upper Ludlow), and the latter Upper Devonian. The corals were, therefore, considered to be of the same age, and to be congeneric, and even conspecific. The diagnoses of *Petraia* are thus framed upon mixed Silurian and Devonian forms, or upon Upper Devonian corals alone, since the latter are much more common.

The Author, by showing that the genotype of *Petraia* is a synonym of *Petraia radiata* Münster, restricts the name to the Upper Silurian species. The Devonian species belong to Pocta's genus *Alleunia.*

The misinterpretation of *Petraia* is particularly unfortunate, since the name is continually used in systematic and phylogenetic literature.

A Fossiliferous Limestone Associated with Ingletonian Beds at Horton-in-Ribblesdale, Yorkshire. By WILLIAM BERNARD ROBINSON KING, O.B.E., M.A., F.G.S.

The paper deals with an exposure of green felspathic grits with associated calcareous rocks in the railway cutting south of Horton-in-Ribblesdale station. The grits have always been referred to the 'Green slate' or Ingletonian series. The limestone has been known since ehe Geological Survey Memoir was published in 1890, and has hitherto been considered part of the Ingletonian series.

In 1921, fossils were discovered in the limestone, and recently a large fauna has been obtained which proves to be of Ashgillian age, and closely comparable with the fauna of the Keisley Limestone of Edenside. If the limestone is interbedded, as appears at first sight, the discovery means that a considerable thickness of the Ingletonian grits are of late ordovician age. The problems of general stratigraphy that this contention raises are discussed, and it is considered that there is much evidence of a general nature to suggest that, although the limestone is undoubtedly of Ashgillian age, the grits with which it is associated must be considerably older.

Calcareous matter occurs in two forms in the cutting; first, as the infilling between the grit blocks of a breccia, and secondly, as a crystalline fosssiliferous limestone apparently interbedded with the grits.

A detailed study of the limestone, howevtr, shows that it is essentially of the same origin as the calcareous part of the breccia, since it contains angular fragments of grit and occasional flakes of roughly-cleaved green mudstone of a type exactly like the Ingletonian of the neighbourhood. The fossils show no signs of distortion by cleavage.

April 1, 1931.

The following papers were read :—

The Glacier-Lakes of Eskdale, Miterdale, and Washdale, Cumberland; and the Retreat of the Ice during the "Main Glaciation." By BERNARD SMITH, M.A., Sc.D., F.G.S.

The ground and its glacial history, described in this communication, furnishes a link between that discussed by the Author before the Society in 1912 (' The Glaciation of the Black Come District, Cumberland ') and that investigated by the Author and his colleagues in the Whitehaven and Workington district.

From a review of the available evidence in the north-west of England it is concluded that the Great Ice Age in Cumberland and the Irish Sea basin comprised at least three main episodes. This paper is confined chiefly to the second—that of the ' Main Glaciation.'

The stages in the formation of the lakes, and their deposits, are described, and the positions of the ice-fronts at different times are indicated. Of the deposits, special

reference is drawn to beaches, especially those fringing islands to normal lake-deltas, and to a variety referred to as 'scale-deltas.' A fine series of moraines was accumulated in water at the snout of the Wasdale Glacier.

Some notes are added upon certain deposits of different character and composition which occur in part of the area covered by Lakes Wasdale and Miterdale, and which are attributed to a later episode (the third) —that of the readvance of Scottish ice. This ice apparently invaded the low ground, and laid down near its termination a large spread of sand and gravel, hummocky in places, but usually with a flattish surface elsewhere. The Scottish ice ponded up in Lower Miterdale a low level lake which may first have drained away into Eskdale at the north-eastern end of Muncaster Fell, but later had an exit near the sea-coast. Laminated clays mark the site of this expanse of water.

'One-Hundred Foot' Raised Beach between Arundel and Chichester. By THE REV. JOSEPH FOWLER, M.A., F.G.S.

Prestwich, in 1858, assumed that the 15-foot raised beach at Brighton is represented by the 100-foot raised beach west of Arundel. Clement Reid seems to accept this identification. There is, however, no proof, either of (1) any differential movement in the general process of elevation, or (2) a fault between the two series that might account for the discrepancy in levels. Moreover, the "rounded shingle,' cited by Prestwich as connecting the two series of marine material, is almost certainly of Tertiary age.

It seems safer to assume the presence of two stages of raised beach—a '100-foot' and a '15-foot' beach. Clement Reid appears really to support this view when he is considering the different ages of the Selsey deposits. So also, more recently, does H. J. O. White. Nevertheless, it must be noticed that there is, apparently, no ascertained example of the 100-foot beach east, or of the 15-foot beach west, of the Arun Valley.

ROYAL INSTITUTION.

At a General Meeting of the Members of the Royal Institution held on March 31, Sir Henry Miers, F.R.S., in the chair, Mr. C. L. Blackburn, Mr. Willard Connely, Mr. S. C. H. Goetze, Professor J. B. S. Haldane, Mr. T. G. N. Haldane, Mr. E. Ogden Ketting, Mr. F. Lydall and Mr. C. H. Marshall were elected Members.

NOTICES OF BOOKS.

Lunge and Keane's Technical Methods of Chemical Analysis. Second Edition. Vol. 3. Edited by DR. C. A. KEANE and DR. P. C. L. THORNE. Pp. xx+678. Gurney and Jackson, 33, Paternoster Row, E.C., and Tweeddale Court, Edinburgh. 1931. Price £3 3s. 0d.

It is gratifying to find that Lunge and Kean's *Technical Methods of Chemical Analysis* is being brought up to date. This standard work is so indispensable that it is used as a constant source of reference by all engaged in analytical work and now that new processes and greater refinements are being introduced the need for revision and extension became urgent.

In Vol. 3 all sections have been completely revised and brought up-to-date by an inclusion of the recent developments of industrial chemistry. This volume includes a very full account of the analytical procedure in connection with clays and ceramics (chemical by H. V. Thompson; physical by S. R. Hind), Glass (J. D. Cauwood), Calcareous Cements (Dr. Geoffrey Martin), Water and Sewage Analysis, Fertilisers (Dr. Bernard Dyer), Soils (Sir A. D. Hall), Air (Dr. J.S . Owen.

It will thus be seen that the work has been entrusted to the care of distinguished specialists and the volume generally, leaves nothing to be desired as regards both mater and completeness.

The sections on Water, with which the reviewer is more familiar are particularly well arranged and practieally all the recently described methods and useful modifications are referred to.

The Editors and contributors are to be congratulated upon their monumental work.

OFFICIAL PUBLICATIONS.

UNION OF SOUTH AFRICA—DEPARTMENT OF AGRICULTURE.

The Home Vegetable Garden in the Karroo—

1. Vegetables and their Culture. By E. L. P. Thomas (Dip. R.H.S.).
2. Insect Pests of the Vegetable Garden. By B. Smit, B.Sc.Agric., M.Sc.
3. Plant Diseases of the Vegetable Garden. By Geo. A. Gill, M.A. Price 3d.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Monday, April 13, at 8 p.m.—(Howard Lecture). "The Present Position in Aeronautics." By N. A. V. Piercy, D.Sc.

Wednesday, April 15, at 8 p.m.—(Ordinary Meeting). "Industrial Lighting." By D. R. Wilson, C.B.E., M.A.

SOCIETY OF CHEMICAL INDUSTRY.

Manchester Section.

Friday, April 10, at 7 p.m., at 17, Albert Square, Manchester. — Annual General Meeting. "Present Position of the Thermal Decomposition of the Lower Hydrocarbons." By Dr. A. E. Dunstan.

LONDON SECTION.

Monday, April 13, at 8 p.m., at Burlington House, Piccadilly—"Studies in the Free Air Cooling of Hot Gases in Mains.' By J. W. Walters.

BIRMINGHAM AND MIDLAND SECTION.

Tuesday, April 14, at 6.30 p.m., at the Chamber of Commerce Buildings, Birmingham.—Annual General Meeting.

NEWCASTLE SECTION.

Friday, April 17, at 7.3 0p.m., at Armstrong College, Newcastle. — Demonstration of Modern Scientific Instruments and Apparatus of Special Interest.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

MANCHESTER SECTION.

Friday, April 10, at 7 p.m., at Milton Hall, Deansgate, Manchester. — Annual Meeting and Smoker.

INSTITUTE OF METALS.

SHEFFIELD SECTION.

Friday, April 17, at 7.30 p.m., at the University, Sheffield.—"Extrusion." By R. Genders.

ROYAL MICROSCOPICAL SOCIETY.

B.M.A. House, Tavistock Sq., W.C.1.

Wednesday, April 15, at 5.30 p.m.—Ordinary Meeting. The following papers will be read and discussed :—

"Improvements in Everyday Technique in Plant Cytology." By L. La Cour.

"On the Preparation of Eel Scales." By Prof. A. Gandolfi Hornyold, D.Sc., F.Z.S., F.R.M.S.

The Biological Section will meet in the Pillar Room on Wednesday, May 6.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

8,040.—I. G. Farbenindustrie Akt.-Ges. —Production of 1.2. benzanthraquinones. March 16.

8,477.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of substituted benzocarbazole carboxylic acids. March 19.

Specifications Published.

344,777. I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of vat dyestuffs of the N-dihydro-1 :2 : 2′-1′-anthra-quinoneazine series.

344,826.—Caro, Dr. N., and Frank, Dr. A. R.—Preparing concentrated nitric acid.

Abstract Published.

340,509.—Anthraquinones.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Anthraquinone and its homologues are obtained by treating the condensation products from 1 molecular proportion of benzoquinone and 2 molecular proportions of the same 1 :3-butadiene, or the re-arrangement products thereof, or the tetrahydroanthrahydroquinones, tetrahydroanthraquinones or corresponding quinhydrones obtainable therefrom by mild dehydrogenation as described in the parent Specification, with a metal salt, the cation of which is capable of assuming a lower valency, *e.g.*, a ferric, cupric or mercuric salt, in an acid medium. The metal salt may be employed in quantities at least equal to those theoretically necessary for the conversion into anthraquinones, or smaller quantities may be employed if the reaction is carried out in the presence of agents, such as oxygen or air, capable of reforming the cations of higher valency. The concentration of the acid may be varied within wide limits; in some cases the acid produced by hydrolysis of the aqueous solutions of the metals is sufficient. In example (1) the condensation product from benzoquinone and 1 :3-buta-

diene (2 mols.) is heated with ferric chloride in glacial acetic acid to form anthraquinone, (2) the re-arrangement product described in example 29 of the parent Specification is heated with a solution of ferric chloride, ferric sulphate, cupric chloride, or mercuric acetate under pressure to form anthrquinone; other cupric salts such as cupric acetate may also be used, and acids, such as acetic acid, may be added to the solutions, and (3) the condensation product from benzoquinone and isoprene (2 mols.) is heated with ferric chloride solution under pressure; 2 :7-dimethylanthraquinone is formed.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

GREYMIN.

520,278.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—The Arcanol Co., Ltd., 35-36, Rathbone Place, Oxford Street, London, W.1. March 25.

IGEPON.

520,340.—All goods in class 1 which includes chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28. Frankfort - on - Main, Germany. March 25.

OLIGAN.

520,513.—All goods in class 1 includes chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. —Society of Chemical Industry in Basle, Switzerland. March 25.

ONDAL.

520,570.—Chemical substances for steeping colouring and brightening textile fabrics and leather in the course of manufacture, but not including coal tar colours.—H. Th. Bohme Aktien-Gesellschaft, 29, Moritzstrasse, Chemnitz, Germany. March 25.

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or *How to Reason Correctly*. By J. E. ROSCOE, M.A., Oxon.

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By the REV. J. E. ROSCOE, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Popé, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

The work is handsomely bound, and has a copious index for easy reference, and the work, containing as it does, the gems of thought on some of the world's greatest thinkers, will form an acquisition to any library.

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A NOTE ON THE INTERACTION OF GLYCEROL WITH CALCIUM OXIDE AND CALCIUM HYDROXIDE.

By T. S. WHEELER.

Grün and Bockisch (*Ber.*, 1908, *41*, 3476) found that when calcium hydroxide is heated with excess of glycerol at 100° for 30 minutes, triglycerol calcium hydroxide, $Ca(C_3H_5(OH)_3)_3(OH)_2$ (I) could be precipitated by addition of acetone to the solution resulting. The yield was about 30 per cent. of the calcium hydroxide employed. The authors do not seem to have examined the undissolved material.

In connection with other investigations it has now been found that the solid material is probably *calcium diglyceroxide* $Ca(C_3H_5(OH)_2O)_2$ (II), the preparation of which does not seem to have been previously described.

Since this result appeared to throw some light upon the manner in which metallic alkoxides are formed from a metal oxide or hydroxide, and an alcohol, under conditions in which the production of ions can scarcely be postulated, the reactions between glycerol and calcium oxide and hydroxide were further investigated, and the following results established :—

1. When the filtered solution obtained by Grün and Bockisch's method is heated at 100° for 48 hours a further precipitate of calcium diglyceroxide is obtained, and no triglycerol calcium hydroxide is separated on addition of acetone to the filtrate.

2. Calcium diglyceroxide is not affected by being heated with glycerol at 100° for 20 hours, and there is no formation of triglycerol calcium hydroxide.

3. If calcium hydroxide is heated with excess of glycerol at 100° for 15 hours, calcium diglyceroxide is the only product obtained, the yield corresponding to all the calcium hydroxide taken.

4. When calcium hydroxide is heated with excess of glycerol at 120°, rapid reaction occurs, and there is obtained calcium glyceroxide, $Ca(C_3H_5(OH)O_2)$ (III) which Destrem (*Ann. chim.*, 1882 (v), *27*, 20) prepared by the interaction of calcium oxide and glycerol above 100$_3$.

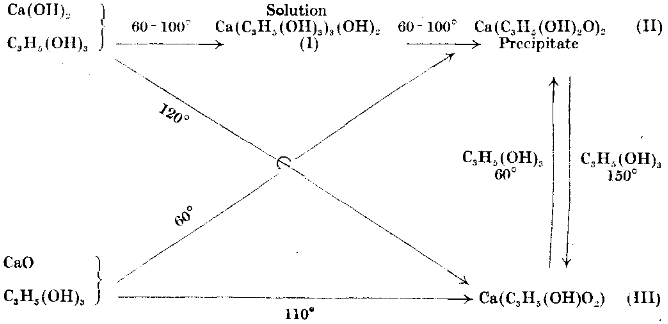
5. Calcium diglyceroxide is formed by heating calcium oxide with excess of glycerol at 60° for 48 hours.

6. When calcium glyceroxide is heated with glycerol at 60° for 48 hours, calcium diglyceroxide is obtained.

7. When calcium diglyceroxide is heated with glycerol at 150° for 10 minutes calcium glyceroxide is formed.

In all these experiments the identities of the products were established by analysis, since, being salts, melting and boiling point criteria were not available.

The results given can be explained by assuming that the first action between calcium hydroxide and glycerol is the rapid formation of triglycerol calcium hydroxide, which passes into solution in glycerol, and then on continued heating splits off two molecules of water and one of glycerol to form calcium diglyceroxide, which is insoluble in glycerol. This reaction proceeds even at 60°. At higher temperatures calcium diglyceroxide passes into calcium glyceroxide. Both the calcium glyceroxides can be transformed one into the other much in the same manner as a normal and a hydrogen salt of a dibasic acid. The results are shown graphically below :—



Effect of water on the formation of calcium diglyceroxide. By heating together known weights of glycerol, water, and calcium hydroxide in sealed tubes at 100°, and estimating the resulting solid product for calcium, it was established that formation of calcium diglyceroxide proceeds until the glycerol reacting contains about 31 per cent. of water.

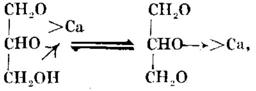
This result might be made the basis of a process for the production of anhydrous glycerol :—excess of aqueous glycerol, concentrated to say 90 per cent., is heated with calcium hydroxide or oxide at 100°, and the resulting calcium diglyceroxide is separated, and treated with carbon dioxide and sufficient water to form calcium carbonate and glycerol. (British patent application No. 37,090/1928.) The difficulty of handling the materials involved would seem to preclude any commercial application.

The acidic nature of glycerol is indicated by the considerable proportion of water necessary to inhibit formation of the calcium salt.

Some reactions of calcium diglyceroxide. Fairbourne and Toms (J.C.S., 1921, *119*, 1035) showed that when monosodium glyceroxide is treated with 1-chloro-2 : 4-dinitrobenzene, or with benzoyl chloride, the corresponding α-glyceryl ether is formed. With disodium glyceroxide (Fairbourne and Foster, J.C.S., 1925, *127*, 2759), tri-substituted glyceryl derivatives were obtained. When calcium glyceroxide was heated with 1-chloro-2 : 4-dinitrobenzene under similar conditions, only tarry matter could be isolated, calcium glyceroxide being much less reactive than monosodium glyceroxide. With benzoyl chloride no reaction was obtained in the cold, but on heating at 80°, rapid formation of tribenzoyl glycerol occurred with separation of calcium chloride. Calcium diglyceroxide and benzoyl chloride gave α-monobenzoyl glycerol, which had previously been pre-

pared by Fairbourne and Toms (*loc. cit.*) from monosodium glyceroxide and benzoyl chloride.

This result indicates that calcium diglyceroxide is an α-glyceryl compound like monosodium glyceroxide. The formation of a trisubstituted glyceryl derivative from calcium glyceroxide can be explained by assuming the formation of a co-ordinate link between the calcium atom and the oxygen of the unsubstituted hydroxyl group thus :—



it being also assumed that there is an equilibrium set up between the two possible forms shown. The results with disodium glyceroxide can be similarly explained.

It may be added that Fairbourne and Foster proved that there was no direct reaction between glycerol and a labile chlorine atom, *e.g.*, that present in 1-chloro-2 : 4-dinitrobenzene. The fact that monosodium glyceroxide and *p*-toluenesulphonyl chloride react to form glyceryl tri-*p*-toluenesulphonate (Fairbourne and Foster, (*loc. cit.*, p. 2762) indicates a tendency to co-ordination even in the monosodium compound.

Experimental.

1. *Preparation of calcium diglyceroxide.* —Calcium hydroxide (5 g.) was heated with glycerol (30 g.) at 100° for 15-30 minutes. The liquid was filtered hot, and the residue washed with hot absolute alcohol and dried in an atmosphere free from carbon dioxide. The product formed a white powder which deliquesced slowly in air, and was decomposed by treatment with moist carbon dioxide. (Found Ca, 17.8 per cent. $Ca(C_3H_5(OH)_2O)_2$ requires Ca, 18.0 per cent.).

2. *Reaction of calcium glyceroxide with benzoyl chloride.* — Calcium glyceroxide (15 g.) was mixed with benzoyl chloride (20 g.) diluted with benzene (20 g.) and kept for 48 hours. As there was no reaction the liquid was boiled under reflux for 30 minutes and filtered. Benzene was removed under reduced pressure and the solid product obtained was recrystallised from alcohol. It melted at 78° and its mixture with tribenzoyl glycerol also melted at the same temperature.

3. *Reaction of calcium diglyceroxide with benzoyl chloride.* — Calcium diglyceroxide (10 g.) and benzoyl chloride (10 g.) were heated together at 100° for 8 hours. The viscous liquid formed was separated from the calcium chloride also produced by extraction with ether. On removal of the ether it solidified in ice and salt, and was found to be identical in composition and properties with the α-monobenzoyl glycerol of Fairbourne and Toms (*loc. cit.*, p. 1040; see also Fischer, Bergmann and Barwind, *Ber.*, 1920, 53, 1589).

Summary.

1. When calcium hydroxide is heated with glycerol at 60-100° triglycerol calcium hydroxide passes into solution, and on continued heating forms *$\alpha\alpha'$-calcium diglyceroxide*, which precipitates. At higher temperatures calcium diglyceroxide passes into calcium glyceroxide.

2. On treatment with benzoyl chloride calcium diglyceroxide forms α-benzoyl glycerol. Calcium glyceroxide on the other hand gives tribenzoyl glycerol, and probably contains a co-ordinate link so that the calcium atom is linked to three oxygen atoms.

3. The formation of calcium diglyceroxide from aqueous glycerol and calcium hydroxide ceases when the aqueous glycerol contains more than 31 per cent. of water.

This work is published in an incomplete state owing to the fact that circumstances have rendered it impossible for it to be completed.

MERCHANDISE MARKS ACT, 1926.

The following is a brief list of the classes and descriptions of imported goods in regard to which Enquiries will be held later :—

(1) Lattice reinforcements and stirrups of iron and steel for concrete construction.
(2) Toys; games (other than sports requisites).
(3) Slider fasteners.
(4) Adhesive insulating tape for electrical purposes.

Any communication on the subject of these Enquiries should be addressed to Mr. E. W. Reardon, at the Board of Trade Offices, Great George Street, London S.W.1.

THE FLASH-POINT TEST FOR LEAD.*

By R. S. Russell, B.Sc.

If lead be heated with concentrated sulphuric acid two distinct actions will usually be observed. In the first, bubbles begin to be evolved more or less rapidly from the lead, and in the second, which occurs as a higher temperature than the first, hydrogen and sulphur dioxide are evolved, free sulphur in liberated, and lead sulphate is formed. The second action may be violent, and usually continues till the lead is all consumed.

Attempts have been made to apply these reactions, by means of a standard procedure, as a "Flash test" for the acid resisting qualities of chemical sheet lead. The purpose of this article is to comment on the best method of performing the test, on the various phenomena which may be observed during the course of it, and on the interpretation of the results when obtained.

Previous Work.

In 1919, Barrs published an account of some tests of lead in concentrated sulphuric acid. The method of performing the test was not described. He noted two actions :—

(*a*) The first action—when a stream of bubbles commenced to arise from the specimen.

(*b*) The second, or vigorous action, when conversion of lead to sulphate commenced.

The higher the temperature of the first action the less vigorous was the second action. He noted that the temperature of flashing could be raised by refining the lead.

In a brief study of the effect of impurities, he noted that copper and tellurium both raised the flash point, whereas Bi, As, Sb, Zn, Sn, Ag, S, all depressed it when any one of them was added in the proportion of 0.2 per cent.

In the discussion, H. W. Rowell stated that the purer lead was the more resistant in sulphuric acid chambers and that copper should not be added.

H. C. Lancaster stated that copper acted simply as a "dope" to overcome the evil effects of deleterious impurities. He had produced electrolytic lead containing 99.998 per cent. Pb, and this had resisted the action of concentrated sulphuric acid at 310° C.

Jones has described five different chemical tests by means of which lead sheet may be examined for commercial use; of these the flash point test is the one he prefers. Sulphuric acid of 96 per cent. H_2SO_4 by weight, he has found, gives figures comparable with those obtained when chamber acid is used. His method of performing the test is to heat a piece of lead 1-in. square and $\frac{1}{16}$-in. thick with 30 cc. acid in such a way that 300° C. will be reached in five minutes. By this means he has found that good chemical lead evolved bubbles of gas at 190-200° C. and flashed at 300-312° C.

The average for Parkes' lead is stated to be :—

Gas evolved—187° C. (average of a large number of tests).

Flash—235° C. (average of a large number of tests).

and this, it is said, makes Parkes' lead unsuitable for some operations without further treatment.

Parrish says that Pattinson lead is to be preferred to Parkes lead, and quotes a test in which Parkes lead, on one side of a chamber, lost more in weight than Pattinson lead on the other side. There is no certainty that the conditions on the opposite sides of the chamber were the same, and the analyses of the two leads are not given. Parrish considers that too much importance has been attached to the flash tests, and points out that the temperature of incipient attack over 200° C. can have little bearing on the attack at temperatures which rarely, if ever, exceed 110° C.

Jones says—"It has become the custom of late to decry what is known as the 'flash test' . . . but if it be applied to lead of 99.99 per cent. purity, and, therefore, containing very little copper, the decomposition of the lead does not occur below 300°, it is advanced that a serviceable metal is under consideration." This may well be believed. If the lead is known to be 99.99 per cent. pure, why do a flash test? Knowledge of the purity of lead necessitates knowledge of the impurities, since lead is determined by difference.

In 1928 the British Engineering Standards Association published a standard specification (No. 334) for chemical lead in which it was stated that "the complete chemical analysis is the only universally sound guide as to the quality of lead."

The flash-point test is recommended as a "useful indicator for the chemical suitability of lead," and a method of performing it is specified.

In a personal communication to Mr. Gilbert Rigg, Mr. H. C. Lancaster, in reference to the flash test, says: " . . . In the light of what I now know it is not sufficiently definite, but samples treated exactly as described give uniformity. If you suspend the sample on a glass triangle or sup-

port on an inverted porcelain crucible, you obtain unduly high flash points. If you cut the lead into a long strip and suspend over the edge of the beaker with the end submerged, you obtain an unduly high result."

Apparently the sample is to lie on the bottom of the beaker.

He continues :—

" . . . We always thoroughly sample by chipping each parcel, melt the chippings into a thin bar about ¼-in. and punch out a ¾-in round piece."

No directions for sampling are given in the British specification.

Brenthel is of the opinion that chemical analysis only is not sufficient to determine whether lead is suitable for use in chemical plant, and that the crystal structure of the metal has a marked effect on its resistance to corrosion by acids. He says that Pattinson lead is more resistant to attack by sulphuric acid and also to fatigue, than Parkes lead, for the reason that it is more finely crystalline. However, he admits the presence of copper in the Pattinson lead, and it seems probable to the present author that a fine crystallinity, the resistance to attack by sulphuric acid, and the resistance to fatigue are each and all of them due to copper.

Mr. D. W. Thompson, of the National Lead Co., U.S.A., has advised Mr. Gilbert Rigg that highly pure lead, very resistant to corrosion, is more subject to coarse recrystallisation than lead containing a small proportion of copper.

Experimental.

A sample of super-refined lead from the works of the Broken Hill Associated Smelters Pty. Ltd., at Port Pirie, was used as a standard. Its composition was as follows :—

	Per cent.
Copper	0.00015
Bismuth	0.00170
Cadmium	0.00020
Tin...	nil
Antimony	0.00360
Arsenic...	nil
Iron	0.00030
Zinc	0.00025
Sulphur...	0.00075
Lead	99.99265 (by diff.)
Silver	0.13 oz./ton

The thermometer used was of the ordinary gas filled, mercury in glass type. It was standardised on pure tin and on lead of the above composition; allowance was made for the temperature of the exposed stem.

The acid was the ordinary chemically pure reagent. Its composition was found by titration against standard alkali, and was checked by means of a hydrometer, due allowance being made for temperature. Acid concentration was found to be 98 per cent.; it was diluted to 96 per cent. It was found that this acid did not begin to bubble vigorously until a temperature of about 340° C. was reached, therefore the tests would not be interfered with by bubbling of the acid.

During the course of a test, free sulphur was formed on the sides of the vessel, and sulphur dioxide was evolved, along with water vapour. The result was that the concentration of the acid remained practically unchanged throughout the test, as was shown by analysis, thus :—

	H_2SO_4 %
Concentration of the acid before the test	95.9
Concentration of the same acid after the test	96.5
Concentration after heating alone in the same way as the test ...	95.6

Since there seemed to be no certainty as to the best method of performing the test, the first experiments were intended to ascertain the effects of—

(a) the volume of acid,
(b) the method of immersing the specimen.
(c) the method of heating.

For these tests, lead of the above composition was cast at 385° C. into a brass mould at 100° C. The block was 8-in. × 4-in. × 1-in., and was rolled cold to sheet ⅛-in. thick. Tests were done with pieces of this lead ½-in. square lying on the bottom of a flask, and also with a strip of the lead hanging over the side of the flask with its lower end dipping into the acid.

Heating was done with a bunsen burner and an open gauze, and was at such a rate that a temperature of 300° C. would be reached in seven minutes if the flash point did not intervene.

The volume of acid varied between 50 and 200 cc. Later, when it was seen that the volume of acid exercised but little effect, a method designed to give greater uniformity of heating was tried. In this method, 150 cc. concentrated sulphuric acid was placed in a 250 cc. flask and a test tube held suitably was placed in the flask and dipping into the acid. The specimen was placed in the test tube and 15 cc. acid was

poured in. The flask was then heated so that the test tube and its contents were heated in a bath of liquid and not by a direct flame.

The specimen was held nearly vertical by the sides of this tube so that acid could circulate freely about it, and the bulb of the thermometer could be placed close alongside it.

This method undoubtedly gave more uniform heating, but when it was found to give no more uniform results, the simpler and more expeditious method of heating direct in a flask was reverted to.

In all these tests it was found that after a few trials the rate of heating could be maintained constant. Of course, the actual time occupied by the test depended on the temperature of the flash.

The volume of the acid and the position of the specimen make but little difference to the flash point itself. The variation in the temperature of the preliminary action may be due to the condition of the surface and to disturbances in the metal caused by cutting the specimen. Such conditions would probably all be smoothed out by the time the temperature of the flash was reached.

Most uniform results are obtained when the sample is suspended into a comparatively large volume of acid.

Some alloys of lead with copper and antimony were subjected to the flash-point test. The alloys were prepared by adding a 5 per cent. mother alloy of copper or of antimony to molten super-refined lead. They were cast and rolled in the same way as the lead itself. The compositions of the alloys were checked by analysis.

When considering the effects of impurities it is interesting to note the results given in the British Engineering Standards Association specification for chemical lead. A list of analyses of chamber leads with their flash points is quoted, and the table shows certain of these analyses, which have been selected for comment. Antimony is generally regarded as a most undesirable impurity.

The Preliminary Actions Associated with the Flash Test.

The actual flashing of the lead is always preceded by actions which may be gentle or vigorous, and which may not be easily distinguishable from the flash itself. It is important that the operator should be able to recognise the various phenomena as they occur, as otherwise the preliminary action may be mistaken for the flash.

The various preliminary actions may be *described as follows* :—

1. Bubbling may begin very gently and the flash occurs.
2. Bubbling may be, as in (1), but it is accompanied by the formation of increase gradually and steadily in vigour, little $PbSO_4$ being formed till much $PbSO_4$, the flash point, however, still being quite sharp and definite.
3. Bubbling may begin as in (1), but there may be a sudden increase in the vigour of bubbling, at a definite temperature.
4. Lead containing .015 per cent. Sb, gives a curious effect. At a definite temperature action suddenly commences, and a layer of $PbSO_4$ forms on the specimen. As temperature rises, the action ceases; then a series of puffs of gas and $PbSO_4$ appear at the surface of the specimen, as many as 9 or 10, at intervals of 2 or 3 seconds; finally, a fairly definite flash is obtained.

   Note.—These preliminary actions will cease when the flame is withdrawn from under the beaker.
5. The action may take place in stages. Bubbling may begin suddenly and vigorously, with formation of $PbSO_4$. After continuing for a short time it may cease suddenly and the $PbSO_4$ may disappear. At a still higher temperature, the action recommences and at a higher temperature still, flashing occurs.
6. The effect of copper is noteworthy. None of the samples containing copper were dissolved completely after flashing. The flash was sluggish, $PbSO_4$ forming only slowly, and the action ceasing when the flame was removed. The specimens formed a thin crust of $PbSO_4$, which could not be removed by rubbing with the fingers; microscopical examination of the specimens, after cleaning in ammonium tartrate solution, showed that attack had been general rather than localized.

It will be seen that a series of standard phenomena cannot be expected; in fact, it it difficult sometimes to tell when the preliminary action ceases and the flash begins. If the phenomena described in example 1 above, say, be taken as standard, then it may be that the deviations from this arbitrary standard noted in the other examples are themselves an indication of the quality of lead. However, there is no relation

known at present between the various phenomena described and any definite property of lead such as its composition, though copper and antimony undoubtedly exercise an effect.

THE NEED FOR A TEST FOR LEAD.

Various methods of testing lead have been described in the literature, but none of them appear reliable .

It is stated that "complete chemical analysis is the only universally sound guide as to the quality of lead."

As regards resistance, this is only partly true, and is subject to the conditions of corrosion being standard, which does not occur in practice. Laboratory tests have indicated that some alloys of lead are as resistant, or more resistant, than lead itself to some forms of corrosion.

As regards resistance to physical stress, the physical properties of lead are now well known:

The purest lead, however, seems to be the most prone to intercrystalline cracking, the most pernicious form of failure to which lead i ssubject. It is ,apparently, caused by minute oscillatory stresses acting for a long period. The cause, the extent, and the dimensions of these stresses have not been worked out for any case of failure.

In the author's experience failure by fatigue or vibration is much more important than failure by straight corrosion, though the latter may help the former.

The only test for resistance to fatigue is that given by the Haigh machine, an expensive installation requiring much time, the services of a good lathe hand, and a trained investigator.

The flash-point test is no guide, as lead which has failed badly by cracking may give an excellent flash.

CONCLUSION.

The flash-point test at the best seems to be merely a test of dubious reliability for the purity of lead. It is dubious because one impurity which has a bad effect may have its influence masked by another which has a good effect, thus the illusion that neither is present might be created.

The tests cannot differentiate between leads which have given good service and those which have had given bad service, nor can it differentiate between lead which will give good service and that which will give bad, for the reason that it does not come anywhere near reproducing the conditions which will be encountered in service.

* From the *Proceedings of the Australasian Institute of Mining and Metallurgy.*

RED LEAD PAINT.

A NOTABLE RESEARCH ON SETTING PROPERTIES.

For the protection of iron and steel against rust and corrosion it has long been known that Red Lead paint has particularly valuable qualities, although the chemical reactions involved, alike as regards the composition of the oxides of lead and the linseed oil, the action between them, and the part played by oxygen, are of the most complicated and largely unexplained character.

One of the most important advances of recent years in the paint world is the use of special "non-setting" Red Lead which enable paint that will keep in good condition to be supplied in bulk as required, of any desired colour (that is not only the natural red) the old hand methods of mixing small quantities of paint as required being now obsolete. This has been rendered possible because of the much more scientific methods employed in manufacturing Red Lead, with the production of a very large number of different varieties to suit special requirements. For paint the ideal is a "non-setting" product, that is without any slow solidifying or "setting" action on the linseed oil.

Essentially of course Red Lead is Plumbic Tetroxide (Pb_3O_4) made by first exposing molten lead to the air at about 645° F., so form yellowish litharge or lead monoxide (PbO). The latter is then oxidised with air at a higher temperature, not over 1000° F., so that the monoxide is converted more or less completely to the red tetroxide, while it will be remembered the paint is made by mixing intimately with linseed oil, thinned as required with turpentine.

Ordinary commercial Red Lead, however, is variable in composition, containing more or less free lead monoxide, while in many respects the tetroxide acts as if it was a mixture of lead monoxide and lead peroxide $2PbO.PbO_2$ and not a separate compound. Apparently the percentage of free lead monoxide in Red Lead determines the proportion of "setting" linseed oil, although opinions differ on the subject.

Some highly interesting researches on the setting of Red Lead paint have recently been carried out in Germany by W. Wullen-Scholton, as described in a recent issue of the "Farben-Zeitung." There was determined the viscosity—time relationships for a considerable number of Red Lead paints made from both "non-setting" and ordinary normal or "setting" Red Lead, having various proportions of the two lead oxides,

and under different conditions as regards amount of linseed oil, degree of grinding, and method of mixing. The results are given in a series of curves, and essentially it is confirmed that increase in the content of actual Red Lead, Pb_3O_4 that is reduction in free PbO, diminishes the degree of setting. Also, other things being equal, the proportion of linseed oil should be as high as possible, while a period of 3-4 days between grinding and thinning out is recommended.

Red Lead paint owes its valuable protective properties bteause in the first place the paint film formed is extremely resistant to oxygen, carbon dioxide, and moisture, whilst being sufficiently tough and elastic to be little affected by the expansion and contraction of the metal and apparently there must be some kind of chemical reaction between the lead and the iron because of the tenacity with which the paint adheres. There are of course very many other uses for Red Lead such as for example, in the manufacture of flint glass, electric storage batteries, safety matches, rubber goods, linoleum, fireworks, and varnishes, and, as indicated, in each case a different variety is used, obtained by altering the methods of manufacture.

EXPLOSIVES IN COAL MINES ORDER.

The Secretary for Mines announces that an Order has been made in pursuance of Section 61 of the Coal Mines Act, 1911, adding to the List of " Permitted Explosives " to be used in certain classes of mines the following explosives :—

(*a*) Doulgas Powder, manufactured by Roburite and Ammonal, Limited.

(*b*) Eversoft Driftex, manufactured by Explosives and Chemical Products, Limited.

(*c*) Polar Ajax, manufactured by Nobel's Explosives Company, Limited.

The Order also amends the definitions of two explosives already on the " Permitted List " and removes from the List certain explosives which are no longer manufactured or used.

Copies of the Order may be purchased, price 2d. net, 2½d. post free ,through any bookseller or directly from H.M. Stationery Office at the following addresses :—Adastral House, Kingsway, London, W.C.2; 120, George Street, Edinburgh; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff.

IMPERIAL CHEMICAL INDUSTRIES CHAIRMAN'S SPEECH, MARCH 31.

How the trade of all countries suffered during 1930 was made clear by figures quoted by Sir Harry McGowan in his speech at the Annual General Meeting of Imperial Chemical Industries, Limited, on Tuesday morning, March 31.

Compared with 1929, the volume of production in the United Kingdom fell 8 per cent., in Germany 16 per cent., Canada 14 per cent., in the U.S.A. 17 per cent. The value of exports from the United Kingdom fell by 22 per cent., from France by 15 per cent., Germany by 11 per cent., Italy by 19 per cent and from the U.S.A. by nearly 26 per cent. These figures did not tell the full story, for so long as we were dependent upon exports we felt any falling-off relatively more than other manufacturing countries.

Having regard to the general decline in world trade, I.C.I. could claim to have done well ,especially since their products were of a secondary nature. Chemicals were the raw materials of all other industries, and thus were moved by circumstances outside their control.

Naturally I.C.I.'s steadily growing overseas business had been affected, but there were bright spots. Despite the internal condition of that country and the low price of silver, sales to China had continued to expand. Both the Australian and South African companies actually earned larger profits than during 1929, and the gross sales of Canadian Industries, Limited, were only a little lower, although the year had seen a contraction in the purchasing power of the Dominion estimated at £70 millions.

Sir Harry congratulated the Government on renewing the Dyestuffs Act till December 31 next, but regretted their refusal to hold the impartial enquiry suggested in Parliament, from which the dye-makers had nothing to fear.

New Compound Fertilisers from Billingham.

Decline in the value of agricultural products had naturally meant a reduction in the purchasing power of the farmer, with the result that the great increase in the sale of fertilisers during recent years had been arrested. Sir Harry announced that a wide new range of concentrated compound fertilisers, having nearly twice the plant food value of any others hitherto manufactured in this country, had recently been developed and were now being produced by Billingham. These new fertilisers would mean

both increased efficiency and a saving in transport, handling and distribution. Sir Harry earnestly urged the British farmer to use them, to study and apply the latest scientific methods to agriculture so as to be able to compete in the home market against foreign competitors, who were already fully alive to the value of chemical aid.

NEW PRODUCTS MADE POSSIBLE BY RESEARCH.

After referrring to the profits and investments of the Company, details of which have already been published, Sir Harry admitted that though research was necessarily a heavy item it was essential to the vitality and efficiency of the chemical industry. Research made for greater efficiency in manufacturing processes, for reduced costs, and for the development of new products. Thus I.C.I. had recently started to make articles never before produced in the United Kingdom, such as synthetic acetic acid, tracer shot-gun cartridges, various products from waste gases, nitro-cellulose plastics for linoleum ,and a wide range of dyestuffs, besides the new fertilisers.

Sir Harry stated that unremitting search for greater economy was being made throughout I.C.I. As the smaller profits of a lowered price level brought lower dividends every organisation like any individual, had to overhaul its expenditure. For this reason he welcomed the appointment of the Government Economy Committee.

FIRST QUALITY PETROL MADE FROM ENGLISH COAL.

During the year much successful work had been done at Billingham on extracting oil from coal by hydrogenation. Costs of production had been much decreased and petrol produced which was equal in quality and anti-knock properties to the finest grades already on the market. Hydrogenation must not be confused with low temperature carbonisation, which produced small quantities of oil as a by-product only. At Billingham coal was hydrogenated into petrol with but a small residue of waste of no value.

" The eventual establishment of this industry in Great Britain will," Sir Harry stated, " be of immense significance in the protection of the national economic and strategic positions."

PROSPECTS OF 1931.

All that Sir Harry could say with regard to the future was that the fall in the price level slowed down. Within a short period an upward trend might appear. Prospects depended upon this movement. " Political developments and the readjustment of adverse budgetary positions, the possibility of co-operation in the control of the world's currency systems, the forced development of German and Russian competition, and other clouds on the industrial horizon present such inscrutable problems as to make forecast hazardous. " You will therefore understand," Sir Harry said, " if I refuse to prophesy." All he would say was that so far as I.C.I. was concerned their products were not luxuries but lay close to the core of the world's manufacturing and consumption needs. They were essential ingredients of the necessaries of civilised life. The structure of the Company was never sounder, its organisation was elastic and virile.

The Company was served by plants of the highest efficiency, by the most skilled and loyal body of workers that any industrial unit could wish for, and by a hard-working and enthusiastic administrative staff.

In short, I.C.I. was admirably equipped to take full and instant advantage of any trade revival that 1931 might have in store.

BRITISH CHEMICALS AND THEIR MANUFACTURERS, 1931.

This is the title of the Official Directory of the Association of British Chemical Manufacturers, 166, Piccadilly, W., and which, we understand, is available *gratis* to genuine users of chemicals upon direct application to the Association. It is published to give purchasers in all parts of the world information as to the products manufactured in Britain. We learn that the combined capital of the members of the Association of British Chemical Manufacturers (all *bona fide* manufacturers) exceeds £200,000,000. The directory will appear in a revised form every two years, the current edition being larger than the 1929 issue.

The alphabetical classified list of products is given in five languages besides English and there are notes and explanations and indexes in these also.

The British Chemical Plant Manufacturers Association has also issued a 1931 directory and it is to be hoped that both these Associations may be successful in introducing their products to more clients both at home and overseas. Copies of these directories can be consulted at *The Chemical News* Offices.

THE I. G. FARBEN-INDUSTRY.

By Hans Steinbach.

Between Cologne and Düsseldorf, where the Rhine broadens out on its way through the lowlands to the sea, lies Leverkusen, the seat of the great " I. G. Farben " industry. Here are manufactured the many tablets ending in " in " or " ol "—pyramidon, aspirin, and countless others intended to quiet the nerves, banish headaches and cure various other ailments. Here there were discovered germanin, plasmochin, antileprol—remedies for the sleeping sickness, malaria and leprosy. It is the city of dyes, sulphuric acid, hydrogen, chromic iron, tar derivatives, synthetic precious stones, hydrochloric acid. And the city is the creation of a man whose name is known and respected not only in Europe but all over the world—Privy Councillor Karl Duisberg.

Duisberg is director-general of the I. G. Farben, chairman of the National Association of German Industry, privy government councillor, doctor of philosophy *in cursu* and holder of eight honorary doctorates ,member of almost all leading German industrial and economic associations, member of the editorial board of the Carnegie Endowment for International Peace, and of the German National Council. He was born on September 29, 1861, as son of a manufacturer in Barmen. When only 20 years old he won the degree of doctor of philosophy at the University of Jena, and turned his attention to chemistry. He attracted the attention of leaders of that science by a number of treatises, and then devoted himself to the production of synthetic indigo and benzopurpurin, a new red synthetic colouring matter. He followed this with the discovery of further dyes and contributed to the world-wide reputation of the dye factories of Friedrich Bayer and Co., of Elberfeld, rising from post to post until he was made director-general. After the organizing of the I. G. Farben trust through the consolidation of eight German concerns manufacturing tar derivatives, Duisberg was made chairman of the board of directors and general manager of the whole great undertaking.

The beginnings of the I. G. concern date from 1891. The growing demand for its products made it necessary to enlarge the plant, and the work was carried out under Duisberg's direction. From it there came into existence the city of Leverkusen. In 1900 there were 4,515 employees; today the number has risen to more than 10,000, in addition to 430 chemists, 20 physicians, 52 apothecaries, 84 engineers, 754 technically trained experts and 2,058 mercantile employees. The concern's own railroad lines are 50 miles long, and the factory buildings with their settlements cover nearly 1,200 acres.

This is Leverkusen—a city of industry, of belching smokestacks and the other features of such towns. But just across the way from this great complex of factories, is a five-acre park belonging to the man who built Leverkusen, is a strange bit of the Orient. It is the Japanese garden of Privy Councillor Duisberg. East Asia on the Lower Rhine !

COMPETITION OF INDUSTRIAL DESIGNS, 1931.

By kind permission of the Board of Governors of the Imperial Institute, the public exhibition of works sent in for this year's open Competition of Industrial Designs organised by the Royal Society of Arts will be held in the Exhibition Pavilion of the Imperial Institute, South Kensington, S.W. Full particulars of the Scholarships and Prizes offered by the Society, and other bodies, for designs for Architec-City Companies, well known manufacturers tural Decoration, Textiles, Furniture, Book Production, Memorial Tablet to R 101, Electric Light Fittings, Silverware, Leather Work, Posters, Showcards, etc., can be obtained from the Secretary of the Royal Society of Arts, Adelphi, London, W.C.2. Application for forms of entry, labels, and instructions must be sent to the Secretary of the Society between May 1 and May 9 and the last day for receiving entries is May 22. The designs entered for the Competition will be received at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W., between June 8 and June 10 and after the judging, which takes place in July, the prize and accepted designs will be exhibited to the public at the Imperial Institute from August 1 and August 31 (Sundays excepted).

The arrangements and schedule of Prizes for the 1932 Competition will be considered in September next, and several other important firms have already notified their intention of offering Prizes in connection with it.

GENERAL NOTES

THIRD INTERNATIONAL CONFERENCE ON BITUMINOUS COAL.

NEW DEVELOPMENTS IN UTILIZATION.

The Carnegie Institute of Technology announces a Third International Conference on Bituminous Coal to be held at Pittsburgh. November 16 to 21, 1931.

The purpose of the Cougress is similiar to that of the Congresses held in 1926 and 1928 by the Carnegie Institute of Technology : to present for discussion the results of recent studies of coal, emphasizing improved methods of utilization and their economic value. The programme will include papers on the carbonization, liquefaction and gasification of coal; by-products; the mechanism of combustion; cleaning of coal and its preparation for the market; pulverised fuel; power plants; domestic heating; etc.

An invitation is extended to scientists of all countries to take part in this Conference.

The president of the Carnegie Institute of Technology, Dr. Thomas S. Baker, has recently returned from Europe where he conferred with many of the leading fuel technologists. The participation of an even larger number of distinguished foreign and American scientists than were present at the two preceding Conferences is assured. The programme which will be presented and discussed will have an international as well as national significance.

Those who desire to submit papers are requested to notify the Secretary as soon as possible. A circular of instructions to authors will be mailed on request.

Messrs. Thomas Cook and Son have been appointed agents of the Conference.

CREOSOTE OIL FOR FINLAND.

The Comercial Secretary to H.M. Legation at Helsingfors reports that the Finnish State Railway Administration is inviting tenders, to be presented in Helsingfors by the 15 April, 1931, for the supply of approximately 900 tons of creosote oil for impregnating purposes.

Firms desirous of offering creosote of United Kingdom manufacture can obtain further particulars of this call for tenders upon aplication to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number F.X.1087 should be quoted.

CANADIAN FELDSPAR AND LIME.

Canadian feldspar enjoys a high reputation in the trade on account of its high potash content, its uniform quality and its freedom from admixed mineral matter, and accordingly, is in demand by mills in the United States grinding feldspar for the ceramic industries.

Lime is made by calcining limestones which as a rule contain less than 3 per cent. of such impurities as silica, alumina, and iron oxide.

CADMIUM IN CANADA.

Cadmium, a by-product obtained in the production of zinc, was produced in Canada for the first time at Trail, British Columbia, early in 1928. Considerable quantities of the metal are employed in Canada, chiefly for plating purposes and, because of this use in connection with the radio and automobile industries, the consumption has increased very rapidly.

DYESTUFFS (IMPORT REGULATION ACT, 1920.

APPLICATIONS FOR LICENCES IN MARCH, 1931

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during March has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 561, of which 439 were from merchants or importers. These were dealt with as follows :—

Granted—525 (of which 524 were dealt with within 7 days of receipt).

Referred to British Makers of similar products—31 (of which 27 were dealt with within 7 days of receipt).

Outsanding on 31st March—5.

Of the total of 561 applications received, 551 or 98 per cent. were dealt with within 7 days of receipt.

FOREIGN COAL, IRON AND STEEL.

Outputs of coal were smaller in January than in the corresponding month of last year, yet France, Belgium, Germany and United States produced more than in December. Production of pig iron and crude steel was also generally considerably less than in January, 1930, but the United States showed distinct advances over December, as also did the United Kingdom. Saar production was also larger.

Proceedings and Notices of Societies

SOCIETY OF PUBLIC ANALYSTS.

An Ordinary Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, April 1, the President, Dr. J. T. Dunn, being in the Chair.

Certificates were read for the first time in favour of :—George Brown, A.I.C., Charles Louden, B.Sc., A.I.C., Charles Percy Money, B.Sc., F.I.C., Martin Priest, F.I.C., Arthur Goodyear Simpson, M.A., Gerrish Smith.

Certificates were read for the second time in favour of :—K. N. Bagchi, B.Sc., M.B., D.T.H., William Nelson Bradshaw, B.Sc., Adrian Joseph Clifford Lickorish, F.I.C., Ernest Grenville Purser, B.Sc., A.I.C., and William Vandell Robson.

The following were elected Members of the Society :—Cecil Chilvers, B.Sc., F.I.C., Jack Hubert Hamence, M.Sc., A.I.C., Cecil John House, B.Sc., A.R.C.Sc., F.I.C., and Henry George Rees, B.Sc., A.R.C.Sc., A.I.C.

The following papers were read and dis cussed :—

Carbon Monoxide Poisoning : Its Detection and the Determination of the Percentage Saturation in Blood, by means of the Hartridge Reversion Spectroscope. By R. C. FREDERICK, A.I.C.

The use of the Hartridge reversion spectroscope and of various accessories to facilitate the accuracy of reading is described. The instrument is shown to be capable of giving a quantitative determination of very small percentages of carbon dioxide in a minnte quantity of blood. The author has been unable to confirm Haldane's conclusions on nitrogen monoxide haemoglobin, haemoglobin spectrum is quite different from that of carbon monoxide haemoglobin.

Experiments on the Hardness of Fats. By H. M. MASON, M.Sc., F.I.C. and G. Walsh, B.Sc., A.I.C.

A simple apparatus has been devised in which the weight required to drive a plunger into solid cake of fat of standard thickness under standard conditions is measured. Graphs are given showing the relationship between three types of plunger—large, medium and small—and relationships have been established between the degree of pressure and the structure of the fat. The results of the hardness test have also been used to establish the identity of fats and to detect adulteration. Tables and curves showing the results obtained with various fats and mixtures are given.

A New Process for the Determination of Small Amounts of Bromide in Chloride. By B. S. EVANS, M.C., Ph.D., F.I.C.

Bromides are rapidly and completely oxidised by chromic acid in the presence of sulphuric acid preferably 8 to 9 N strength, whilst chlorides remain untouched. The liberated bromine is conveyed by means of a current of air into an absorption flask containing standard arsenious oxide solution and some sodium bicarbonate, and the excess of arsenious acid is titrated with standard iodine. For determining small percentages of bromides in chlorides the bromide is first absorbed in a tube containing 0.5 per cent. sodium hydroxide solution, and this solution is then treated with one or two drops of saturated sulphur dioxide solution, then with dilute sulphuric acid and chromic acid, and the determination completed as described.

The Use of Bromine as a Reagent in the Determination of Alkaloids. By S. G. WALTON and R. G. O'BRIEN.

The thalleioquin reaction for quinine has been made quantitative, the excess of bromine being removed by aeration, and the colouration compared with that given by standard solutions. An iodimetric development of the method enables quinine to be determined in the presence of other alkaloids. The bromine compounds of morphine and most of the other opium alkaloids liberate iodine from potassium iodide, and methods of determination are based on the reactions. Codeine may be determined colourimetrically by measuring the depth of the red colour formed on oxidising its bromine compound with hydrogen peroxide. Colourirmetric methods have also been devised for the ipecacuanha alkaloids, based on the yellow colouration formed on aerating the bromine compounds.

THE CHEMICAL SOCIETY OF JAPAN.

The following papers were read :—

Researches on Reagents for Alcohols. II. 4'-Iodo-biphenyl-urethanes derived from C_1—C_{18} Normal, Saturated, Primary Alcohols. By SINITI KAWAI AND KUNISABURO TAMURA.

Velocity of Permeation of Electrolytes through a Membrane. IV. Quantities of

Solutions on the Both Sides of a Membrane and the Velocity of Permeation. By SINNOSUKE MATSUURA.

...Velocity of Permeation of Electrolytes through a Membrane. V. Permeation of Two Kinds of Electrolytes with a Common Ion. I. By SINNOSUKE MATSUURA.

Volatile Constituents of Cunninhamia *sinensis R. Br. II.* By KINZO KAFUKU AND RYO KATO.

Sinomenine and Disinomenine. XXIII. Identity of β-Tetrahydro-desoxy-codeine and Dihydro-thebacodeine. By KAKUJI GOTO AND SHINGO MITSUI.

Catalytic Reaction between Stannic Oxide and Lime. By SETSURO TAMARU AND NOBORU ANDO.

Stannites of Calcium, Strontium, and Barium. By SETSURO TAMARU AND HARUO SAKURAI.

Enzymatic Studies on the Volatile Sulphur Compound in "Ninniku" (Allium scorodoprasum *L. var.* viviparum *Regel*). By TOKURO SODA AND HIROTACE TERASAZI.

...Studies on the Adsorbed Moisture in the Kanbara Clay. By HAJIME ISOBE.

Sinomenine. XIX. Reduction of Sinomenine and Hydrosinomenine by Sodium Amalgam. By KAKUJI GOTO AND SHINGO MITSUI.

Sinomenine. XX. Benzene-azosinomenine. By KAKUJI GOTO AND HIDEO SHISHIDO.

Sinomenine. XXI. The Reaction Between Sinomenine and Formaldehyde. By KAKUJI GOTO, HIDEO SHISHIDO AND REIKICHI INABA.

The Essential Oil of Artemisia capillaris, *Thunb. I.* By JUNZO ARIMA AND TEIJI OKAMOTO.

The Determination of Titanium, Tin and Lead. (Studies on gravimetric analysis by means of the Thermobalance. VII.) By KANEYASU MURAYAMA.

The Catalytic Action of Active Carbon. I. The Catalytic Action of Active Carbon on Menthone and Piperitone. By SEIZO KIMURA.

Studies on Sinomenine. By KAKUJI GOTO.

Electrolytic Oxidation of Glutamic Acid. The Electrolytic Reactions of the Amino Acids and Related Compounds. I.) By YOSHITARO TAKAYAMA.

Determination of the Thermal Dissocia-Electrolytic Reaction of Leucinic Acid. By YOSHITARO TAKAYAMA AND HARUMI OOEDA.

Determination of the Thermal Dissociation of Calcium Carbonate by Thermanobalance. By SETSURO TAMARU AND SEIMEI ADACHI.

NOTICES OF BOOKS.

Industrial Microbiology. A Manual and Guide-Book on the Utilization of Bacteria, Yeasts and Molds in Industrial Processes. By PROF. HENRY FIELD SMYTH, M.D., AND PROF. WALTER LORD OBOLD, M.Sc. Pp. x + 313. Baillière, Tindall and Cox, 8 Henrietta Street, London, W.C.2. 1930. Price 27s.

This manual and guide-book on the Industrial Microbiology and other utilisations and the moulds surveys the whole subject.

The applications of bacteriology in industry are manifold and increasing in importance from year to year as new applications are found and better means of control discovered.

Curiously enough, no publication has hitherto been devoted primarily to these applications, which may be considered either as a phase of industrial chemistry or as a phase of applied microbiology.

The present volume fills this gap in the literature. It brings together the information from widely scattered sources and adds thereto the material gleaned by the authors in their own experience as investigators.

The book is inteuded for the use of technical workers already engaged in industrial microbiology and for students who plan to enter this field of endeavour.

The material has been selected with a view to its important practical bearing, with the stress laid particularly on the microörganismal phase ,the source of the organisms involved, methods of obtaining them and of controlling their proper fuuctioning in plant-scale operations. Bibliographies accompany each chapter.

NON-INTERPOLATING FOUR-PLACE ANTILOGARITHMS.

(No.n 4 of the Simplified Series.)

Non-Interpolating Logarithms, Cologarithms, and Antilogarithms. By FREDERICK W. JOHNSON, M.A. The Simplified Series Publishing Company, San Francisco, California, U.S.A. 1931. Price 4 dollars.

Non-Interlogating Logarithms, Cologarithms, and Antilogarithms, contains ten complete tables, none of which require any interpolation or calculation of any kind. These tables include (I) five-place logarithms of all five-place number, (II) five-place antilogarithms of all five-place logarithms, (III) four-place logarithms of all four-place numbers, (IV) four-place colo-

garithms of all four-place numbers, (V) four-place antilogarithms of all four-place logarithms. Besides these principal tables there are tables giving (a) five-place cologarithms of all three-place numbers, (b) the values of seconds of arc of all angles from 0° to 3° at intervals of 10″, (c) the values of S and T for all angles from 0° to 2° 49′ at intervals of 1″, (d) the values of C S and C T corresponding to the logarithmic functions of small angles, (e) formulas for the use of S and T, and (f) a selected list of constants together with their logarithms and cologarithms, including atomic weights, metric conversion factors, chemical, physical, and mathematical constants, and decimal equivalents of common fractions. Finally, the book contains an unusually full and well-illustrated explanation of the process of logarithmic calculation in general; and it is provided with a marginal thumb-index similar to the one shown herewith—a cut-out tab on each leaf of all tables. This index enables one to open the book, with practically a single motion, to any logarithm, cologarithm, antilogarithm, or any other value in the entire book.

Chemical Manufacturers' Directory. 1931. Pp. 205. London: Newnham, Cowell and Gripper, Ltd., 75 Chiswell Street, E.C.1. Price 4s. 6d.

The sixty-third edition of the *Chemical Manufacturers' Directory* of England, Scotland and Wales, with some of the Firms in Ireland has just been issued. It contains the names of practically all the chemical manufacturers of the above countries ,and should therefore prove very useful to all those connected with chemistry and the chemical trade. A classified list of chemicals ,showing the makers of each kind together with a list of chemical brokers and chemical manufacturing agents in London are also given.

OFFICIAL PUBLICATIONS RECEIVED.

United States Department of the Interior Geological Survey.

Surface Water Supply of the United States 1926. Part XII, North Pacific Slope Drainage Basins. B. Snake River Basin. By N.C. Grover, Chief Hydraulic Engineer. Water Supply Paper 683. Price 40 Cents.

Bibliography of North American Geology 1919-1928. By John M. Nickles. Bulletin 823. Price $1.25.

Names and Definitions of the Geologic Units of California. Compiled by M. Grace Wilmarth. Bulletin 826. Price 20 Cents.

United States Department of Commerce. Bureau of Standards.

Aromatic Red Cedar Closet Lining. Commercial Standard CS26-30. Price 5 Cents.

Mopsticks. Commercial Standard CS2-30. Price 5 Cents.

The Makin of Mirrors by the Deposition of Metal on Glass. Circular of the Bureau of Standards, No. 389. Price 5 Cents.

Units used to express the Wave Lengths of Electromagnetic Waves. By Henry D. Hubbard. Price 5 Cents.

Use of Bismuth in Fusible Alloys. Circular of the Bureau of Standard, No. 388. Price 5 Cents.

Builders Hardware. (Nontemplate). Commerical Standard CS22-30. Price 10 Cents.

Union of South Africa. Department of Agriculture.

Handling of Citrus Fruits in Relation to Subsequent Wastage. By I. B. Pole Evans, C.M.G., M.A., D.Sc., F.L.S., with Reports on Inspection of Packing Houses in various South African Citrus Areas. By B. Hahne, Pt.D. Bulletin No. 98. Price 6d.

Turkeys as a Profitable Sideline on the Farm. By E. F. Lombard. Bulletin No. 86. Price 6d.

The Deciduous Fruit Export Season 1929-1930. Report By V. A. Putterill. Bulletin No. 95. Price 6d.

Scientific Papers of the I nstitute of Physical and Chemical Research, Komagome, Hongo, Tokyo, Japan.

On the Hydrosol of Silicic Acid I. Hydrosol made from Ethyl Silicate by Hydrolysis. Nos. 278-281. By Kenkyo Inaba.

On the Hydrosol of Silicic Acid II. On the Electrical Properties of the Hydrosol of Silicic Acid. By Kenkyo Inaba.

On the Relations of Vitamins to Carcinogenisis. By Waro Nakahara.

Some Remarks in the Angular Intensity Distribution of Continuous X-Ray Spectrum III. By Yoshikatsu Sugiura.

Spectrum of Singly Ionized Chlorine (CL. II). By Kiyoshi Murakawa, No. 282.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.
John Street, Adelphi, W.C.2.

Monday, April 20, at 8 p.m.—(Howard Lecture). "The Present Position in Aeronautics." By N. A. V. Piercy, D.Sc. (Lecture II).

Wednesday, April 22, at 8 p.m.—(Ordinary meeting). "The Work of the London School of Hygiene and Tropical Medicine." By Professor Major Greenwood, D.Sc., F.R.S., F.R.C.P. The Paper will be followed by a demonstration of a Malaria Film by Professor John G. Thomson, M.A., M.B.

Friday, April 24, at 4.30 p.m.—(Indian Meeting.) "John Zoffany in Indian." By Sir William Foster, C.I.E.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.
BELFAST AND DISTRICT SECTION.

Wednesday, April 22. Visit to Stormount Research Station.

SOCIETY OF DYERS AND COLOURISTS.
MANCHESTER SECTION.

Friday, April 17, at 7 p.m. in the Lit. and Phil. Society. Annual Meeting and Short Papers by the Members.

SOCIETY OF CHEMICAL INDUSTRY.
NEWCASTLE SECTION.

Friday, April 17, at 7.30 p.m. Armstrong College, Newcastle. Demonstration of Modern Scientific Instruments and Apparatus of Special Interest.

Wednesday, April 22, at 7 p.m. Techni-College, Derby. "Diffusion in Solids." By Dr. A. Bramley.

INSTITUTE OF METALS.
SHEFFIELD SECTION.

Friday, April 17, at 7.30 p.m. University, Sheffield. "Extrusion." By R. Genders.

INSTITUTE OF FUEL.
EAST MIDLANDS SECTION.

Friday, April 17, at 7 p.m.—University College, Nottingham. "Theory and Practice of the Gasification of Coal in Producers." By H. L. Pirie.

INSTITUTE OF BREWING.
YORKSHIRE AND NORTH-EASTERN SECTION.

Friday, April 17.—Queen's Hotel, Leeds. Annual Meeting and Dinner.

PHYSICAL SOCIETY.

Friday, April 17, at 5 p.m.—Imperial College of Science, S.W.1.

INSTITUTION OF ELECTRICAL ENGINEERS.

Friday, April 17, at 7 p.m.—Savoy Place, W.C.2. "Current Transformer Summations." By E. W. Hill and G. F. Shotter.

April 17 and 18.

Faraday Society. University, Liverpool. General Discussion in Photo-chemical Process. 1.0 a.m., "Molecular Spectra in Relation to Photochemical Change." Introductory Paper by Prof. R. Mecke. 2.30 p.m. "Photochemical Kinetics in Gaseous Systems." Introductory Paper by Prof. M. Bodenstein. April 18, at 10 a.m. "Photochemical Change in Liquid and Solid Solutions." Introductory Paper by Prof. Berthoud. 2.30 p.m., "Photosynthesis." Introductory Paper by Prof. E. C. C. Baly.

CHEMICAL ENGINEERING GROUP.

April 24. Twelfth Annual General Meeting, Waldorf Hotel, Aldwychm, W.C., at 6.45 p.m. Dinner, 7.15 for 7.30 p.m. Tickets 12s. 6d. No Ladies.

INSTITUTE OF FUEL.

April 21. North Western Section. 17, Albert Square, Manchester, at 7 p.m. Annual General Meeting. "Fuel Technolog and the Classification of Coal." By C. A. Seyler.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

9,374.—I. G. Farbenindustrie Akt.-Ges. —Purification of acetylene. March 27.

9,376.—I. G. Farbenindustrie Akt.-Ges. —Removal of phenols from hydrocarbons. March 27.

9,494.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of amino-ethers. March 28.

8,931.— Imperial Chemical Industries, Ltd., and Coffey, S.—Manufacture of barbituric acids. March 28.

Specifications Published.

345,208.— Vereinigte Glanzstoff-Fabriken Akt.-Ges.—Manufacture of cellulose pulp for use in the chemical industry.

345,253.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of unsaturated ethers.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

BACO PENET.

520,419.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. —Bachmeier and Co., Inc., 438 to 448, West 37th Street, New York, State of New York, United States of America. April 1. (Associated).

MULTAGLUTE.

520,989.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. — Novadel, Ltd., St. George's Works, 6, Hill Street, Blackfriars Road, London, S.E.1. April 1.

FLUTOL " B."

520,736.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—Damp-Proofing, Ltd., U.K. Works, Gosterwood Street, Deptford, London, S.E.8. April 1.

VITASEED.

519,609.—*Chemical substances in class 2 for dressing or treating seeds.*—Cecil Charles Hansford, trading as The Vitaseed Co., 43, Prince Street, Bristol. April 1.

GRAMMAR OF LOGIC.

***100 Questions and Answers on The Grammar of Logic* or *How to Reason Correctly.* By J. E. ROSCOE, M.A., Oxon.**

An invaluable Book for all who desire to excel as speakers and who wish to reason convincingly.

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This large Volume contains a detailed Index to the first 100 Volumes of the *Chemical News*, and will be found of great value to all interested in Chemical Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

CONFESSIONS OF GREAT SOULS.

By the REV. J. E. ROSCOE, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

The work is handsomely bound, and has a copious index for easy reference, and the work, containing as it does, the gems of thought on some of the world's greatest thinkers, will form an acquisition to any library.

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Surplus Books For Sale At Bargain Prices.

A list of various Important Scientific Books for Sale at usually ***less than half published prices*** *will be sent on application to the Manager, Chemical News, Merton House, Salisbury Square, London, E.C.4.*

THE COLLINSICS OF MINERALS. XVIII.

By HAWKSWORTH COLLINS, B.A. (Camb.).

In Table XLII 19 collinsics are given, introducing several more elements. Six of these have optical refractivities, which are exactly the same as their relative volumes. Three other cases of the same nature have previously been demonstrated. Table XLI gives the full list of these results, which have been obtained by discovery, no hypothesis at all being involved in the matter.

These coincidences cannot possibly have happened by accident, and therefore there is some fundamental reason for the facts, especially as there are also seven cases in the preceding collinsics in which the O.R. of an element is equal to another volume of the same element, but not to that volume which produces that particular O.R.

Only 26 elements have so far been brought into the collinsics, and this matter concerns 16 of them.

A real hypothesis is now going to be made in order to suggest a reason for the coincidences contained in Table XLI. (If in the future it is proved that the hypothesis is not correct the certainties contained in the collinsics will not be affected in the slightest).

The hypothesis is that:—When a ray of light passes through an atom without missing any part of it, the optical refractivity is equal to the relative volume. Or, in other words, this occurs if the atom happens to be lying lengthwise in a crystal and not crosswise to the ray of light.

TABLE XLI.

	Rel. Vol.	Opt. Ref.
B ...	3.865 ..	3.865
Ca ...	13.25 ...	13.25
N ...	3.8 ...	3.8
Sr ...	19.56 ...	19.56
Cr ...	21.73 ...	21.73
I ...	27.75 ...	27.75
V ...	17.76 ...	17.76
Ni ...	11.53 ...	11.53
Br ...	18.05 ...	18.05

WHAT IS A COLLINSIC?

Collinsics are exact discoveries, which show the connection between the recognised chemical structure of each substance, its molecular weight, its specific gravity, and its refractive index; *i.e.*, there are four series of scientific data upon which each collinsic is built.

These collinsics, when found, produce two other series of scientific facts, *viz.*, the

relative volumes of the atoms in the molecule (which have been shown to be the Fundamental Constants of Nature), and the optical refractivity of each atom.

In other words :—

A Collinsic is an exact mathematical deduction upon all experimental data concerning a substance. But this deduction does not depend only upon the experimental facts concerning the particular substance under consideration, but upon those of all substances.

TABLE XLII.
THE COLLINSICS OF NINETEEN MINERALS.

(210) Iodyrite AgI
Theor. S.G. **5.702** — Obs. S.G. 5.70 D 5.707 D
Ag I
48.546 = 1.1829(13.29 + 27.75)
Theor. R.I. 2.1829 — Obs. R.I. 2.1816 D
48.54 = 20.79 + 27.75

(211) Bromyrite $AgBr$
Theor. S.G. **5.97** — Obs. S.G. 5.8–6.0 D
Ag Br
38.8428 = 1.2394(13.29 + 18.05)
Theor. R.I. **2.2394** — Obs. R.I. 2.2533
38.84 = 20.79 + 18.05

(212) Miersite $CuAg_4I_5$
Theor. S.G. **5.657** — Obs. S.G. 5.64 M
Cu Ag I
235.132 = 1.18133$(\mathbf{7.13} + \mathbf{13.29}_4 + \mathbf{27.75}_5)$
Theor. R.I. **2.18133** — Obs. R.I. 2.200 S
235.13 = $\mathbf{13.22} + \mathbf{20.79}_4 + \mathbf{27.75}_5$

(213) Strontianite $SrCO_3$
Theor. S.G. **3.69** — Obs. S.G. 3.69 M
Sr C O O_2
27.235 = 0.679$(\mathbf{19.56} + \mathbf{8} + \mathbf{7.53} + \mathbf{2.51}_2)$
Theor. R.I. **1.679** — Obs. R.I. 1.67 M
27.239 = $\mathbf{19.56} + \mathbf{3.333} + \mathbf{1.654} + \mathbf{1.346}_2$

(214) Svanbergite $Sr_2Al_6P_2S_2O_{22}.6H_2O$
Theor. S.G. **3.154** — Obs. S.G. 3.30 D 2.571 Brei
Sr_2 Al_6 P_2 S_2 O_{22} Aq_6
187.87 = 0.6412$(\mathbf{19.56}_2 + \mathbf{9.05}_6 + \mathbf{14.56}_2 + \mathbf{15.53}_2 + \mathbf{2.51}_{22} + \mathbf{14.03}_6)$
Theor. R.I. **1.6412** — Obs. R.I. N1.64 W
187.874 = $\mathbf{19.56}_2 + \mathbf{7.865}_6 + \mathbf{10.51}_2 + \mathbf{5.75}_2 + \mathbf{1.346}_{22} + \mathbf{6.572}_6$

(215) Celestite $SrSO_4$
Theor. S.G. **4.08** — Obs. S.G. 4.0 W
Sr S O_4
30.693 = 0.6801$(\mathbf{19.56} + \mathbf{15.53} + \mathbf{2.51}_4)$
Theor. R.I. **1.6801** — Obs. R.I. 1.667 M
30.694 = $\mathbf{19.56} + \mathbf{5.75} + \mathbf{1.346}_4$

(216) Am.dihydrogen arsenate AmH_2AsO_4
Theor. S.G. **2.308** — Obs. S.G. 2.308 Topsoe
Am. H_2 As O_2 O_2
38.971 = 0.5657$(\mathbf{23.87} + \mathbf{5.76}_2 + \mathbf{19.58} + \mathbf{4.45}_2 + \mathbf{2.51}_2)$
Theor. R.I. **1.5657** — *Obs. R.I.* N_o1.5766 Topsoe
N_e1.5217 *Topsoe*
38.972 = $\mathbf{9.81} + \mathbf{2.813}_2 + \mathbf{17.75} + \mathbf{1.747}_2 + \mathbf{1.346}_2$

(217) Am. iron sulphate $Am_2FeS_2O_8.6H_2O$
Theor. S.G. **1.839** Obs. S.G. 1.848 P & J. 1.813 Schiff
Am_2 Fe S_2 O_4 O_4 Aq_6
$102.132 = 0.479(23.87_2 + 10.08 + 15.53_2 + 7.53_4 + 2.51_4 + 14.03_6)$
Theor. R.I. **1.479** Obs. R.I. 1.490 C.R.P.C.
$102.132 = 9.81_2 + 19.58 + 5.75_2 + 1.654_4 + 1.346_4 + 6.572_6$

(218) Struvite $AmMgPO_4.6H_2O$
Theor. S.G. **1.71** Obs. S.G. 1.72 W 1.7 D
Am Mg P O O_3 Aq_6
$71.53536 = 0.4992(23.87 + 8.71 + 14.56 + 4.45 + 2.51_3 + 14.03_6)$
Theor. R.I. **1.4992** Obs. R.I. 1.497 D 1.502 D
$71.5385 = 9.81 + 6.0015 + 10.51 + 1.747 + 1.346_3 + 6.572_6$

(219) Anhydrite $CaSO_4$
Theor. S.G. **3.04** Obs. S.G. 2.983 Sehra. 3.102 Filh.
Ca S O O O_2
$27.5335 = 0.615(12.24 + 15.53 + 7.53 + 4.45 + 2.51_2)$
Theor. R.I. **1.615** Obs. R.I. 1.614 D
$27.5315 = 15.6885 + 5.75 + 1.654 + 1.747 + 1.346_2$

(220) Pirssonite $CaNa_2(CO_3)_2.2H_2O$
Theor. S.G. **2.353** Obs. S.G. 2.352 D
Ca Na_2 C_2 O_4 O_2 Aq_2
$52.908 = 0.51442(12.24 + 11.865_2 + 8_2 + 4.45_4 + 2.51_2 + 14.03_2)$
Theor. R.I. **1.51442** Obs. R.I. N_m 1.509 W
$52.9085 = 15.6885 + 3.865_2 + 3.333_2 + 1.747_4 + 1.346_2 + 6.572_2$

(221) Dietzeite $CaCrO_4.CaI_2O_6$
Theor. S.G. **3.7** Obs. S.G. 3.7 W
Ca_2 Cr I_2 O_3 O_3 O_4
$124.1925 = 0.8409(12.24_2 + 21.73 + 27.75_2 + 7.53_3 + 4.45_3 + 2.51_4)$
Theor. R.I. **1.8409** Obs. R.I. N_m1.842 N_p1.825 W
$124.194 = 15.6885_2 + 21.73 + 27.75_2 + 1.654_3 + 1.747_3 + 1.346_4$

(222) Calciovolborthite $CaCu(OH)VO_4$
Theor. S.G. **3.58** Obs. S.G. 3.86 D 3.495 D
Ca Cu H V O_4 O
$59.1671 = 0.9018(12.24 + 9.54 + 5.76 + 17.76 + 4.45_4 + 2.51)$
Theor. R.I. **1.9018** Obs. R.I. 1.92 W
$59.1655 = 15.6885 + 14.77 + 2.613 + 17.76 + 1.747_4 + 1.346$

(223) Potassium chrome alum $KCrS_2O_8.12H_2O$
Theor. S.G. **1.824** Obs. S.G. 1.826 Play
1.823 16.5 Spri
K Cr C_2 O_2 O_6 Aq_{12}
$130.953 = 0.4787(22.29 + 21.73 + 15.53_2 + 7.53_2 + 2.51_6 + 14.03_{12})$
Theor. R.I. **1.4787** Obs. R.I. 1.48137 S
$130.968 = 7.49 + 21.73 + 5.75_2 + 1.654_2 + 1.346_6 + 6.572_{12}$

(224) Am. chrome alum $AmCrS_2O_8.12H_2O$
Theor. S.G. **1.738** Obs. S.G. 1.738 21 Schr
Am Cr S_2 O_2 O_6 Aq_{12})
$133.286 = 0.48443(23.87 + 21.73 + 15.53_2 + 7.53_2 + 2.51_6 + 14.03_{12}$
Theor. R.I. **1.48443** Obs. R.I. 1.48418 S
$133.288 = 9.81 + 21.73 + 5.75_2 + 1.654_2 + 1.346_6 + 6.572_{12}$

(225) Morenosite $NiSO_4.7H_2O$

Theor. S.G. **1.933** Obs. S.G. 1.931 Schiff

$$\begin{array}{l} \quad\quad\quad\quad\quad\quad Ni \quad\quad S \quad\quad O_2 \quad\quad O_2 \quad\quad Aq_7 \\ \mathbf{69.288 = 0.4767(11.53 + 15.53 + 7.63_2 + 2.51_2 + 14.03_7)} \end{array}$$

Theor. R.I. **1.4767** Obs. R.I. 1.4669-1.4888 D

$$\mathbf{69.284 = 11.53 + 5.75 + 1.654_2 + 1.346_2 + 6.572_7}$$

(226) Am. nickel selenate $Am_2NiSe_2O_8.6H_2O$

Theor. S.G. **2.245** Obs. S.G. 2.228 Topsoe
2.274 15.8 Pett

$$\begin{array}{l} \quad\quad\quad\quad\quad\quad Am_2 \quad\quad Ni \quad\quad Se_2 \quad\quad O \quad\quad O_3 \quad\quad O_4 \quad\quad Aq_6 \\ \mathbf{117.717 = 0.5426(23.87_2 + 11.53 + 21.29_2 + 7.53 + 4.45_3 + 2.51_4 + 14.03_6)} \end{array}$$

Theor. R.I. **1.5426** Obs. R.I. 1.5372-1.5466 C.R.P.C.

$$\mathbf{117.721 = 9.81_2 + 11.53 + 17.43_2 + 1.654 + 1.747_3 + 1.346_4 + 6.572_6}$$

(227) Lautarite Ca I_2O_6

Theor. S.G. **4.583** Obs. S.G. 4.59 W

$$\begin{array}{l} \quad\quad\quad\quad\quad\quad Ca \quad\quad I_2 \quad\quad O_6 \\ \mathbf{74.096 = 0.8707(14.54 + 27.75_2 + 2.51_6)} \end{array}$$

Theor. R.I. **1.8707** Obs. R.I. 1.888-1.792 W

$$\mathbf{74.096 = 10.52 + 27.75_2 + 1.346_6}$$

(228) Am. Copper selenate $Am_2CuSe_2O_8.6H_2O$

Theor. S.G. **2.214** Obs. S.G. 2.221 Topsoe

$$\begin{array}{l} \quad\quad\quad\quad\quad\quad Am_2 \quad\quad Cu \quad\quad Se_2 \quad\quad O_4 \quad\quad O_4 \quad\quad Aq_6 \\ \mathbf{119.1 = 0.537(23.87_2 + 7.13 + 21.29_2 + 7.53_4 + 2.51_4 + 14.03_6)} \end{array}$$

Theor. R.I. **1.537** Obs. R.I. 1.5355-1.5395 C.R.P.C.

$$\mathbf{119.132 = 9.81_2 + 13.22 + 17.43_2 + 1.654_4 + 1.346_4 + 6.572_6}$$

Explanation of the Collinsic of Iodyrite.

Iodyrite is here taken as an example for explaining all collinsics.

If the molecular weight be divided by the sum of the atomic volumes (given between brackets in the third line) the result is the theoretical specific gravity of the pure substance, which lies between the observed S.G.'s of the impure substance. If the molecular volume be multiplied by $\mu-1$, *i.e.*, by 1.1829, the result is identical to four figures with the sum of the optical refractivities of the atoms (given in the last line).

The theoretical R.I. 2.1829, as required for this operation differs from the only given observed R.I., 2.1816, by about one in 2,000, *i.e.*, one-twentieth per cent.

The two values obtained for the R.V. and O.R. of Ag are called a voloptic, and are inseparable in all substances; *i.e.*, if the R.V. of Ag is found to be 13.29 in any other mineral, its O.R. must be 20.79. Also if 27.75 is found to be the R.V. of iodine in any other mineral, its O.R. must be 27.75. This shows the way in which the collinsic of any particular substance is dependent upon those of other substances.

It is evident that impurities are thus eliminated from all collinsics, because a *voloptic takes no notice at all of* an impurity in any one substance, and therefore it cannot take into account the impurities in any substance.

The collinsics, therefore, form an entirely new and exact method of research.

The Structure of an Atom of Calcium.

An atom of Ca has previously been shown in the *Chemical News* to have been formed, either by the union of one atom of Si with *one of C, or by one of* K *with one of* H; *the* two forms being the same by the Interrelationship of the Elements.

The three volumes of Ca, 14.54, 13.25 and 12.24 were found 20 years ago, and have frequently been demonstrated in the *Chemical News, especially when the structure of* Ca, and the Law of Heat of Formation were under consideration.

Now that it has been proved that the values obtained for the O.R. of an atom are very frequently identical with a relative volume of the same element, Table XLIII gives a perfect corroboration of the matter regarding the structure of an atom of calcium with mathematical certainty.

TABLE XLIII.

THE STRUCTURE OF CALCIUM.

R.V. 14.54 = 13.88 (Si) +0.71(C)
corresponds with
O.R. 10.52 = 7.49 (K) +3.03(H)

R.V. 13.25 = 7.49 (K) +5.76(H)
corresponds with
O.R. 13.25 = 7.49 (K) +5.76(H)

R.V. 12.24 = 11.53 (Si) +0.71(C)
corresponds with
O.R. 15.6885 = 13.02 (Si) +2.6685(C)

The only values in Table XLIII which have not occurred frequently are 3.03(H) which has only appeared in the structure of nitrogen, and the O.R. 2.6685 of the R.V. 0.71 of carbon; but when an opportunity occurs for considering organic molecules, this last voloptic will be found to be the commonest of all, as it appears in about 90 per cent. of all the thousands of organic molecules.

A NOTE ON THE DENSITY OF β-OCTANOL.

By T. S. WHEELER.

Samples of *d*- and *l*-β-Octanol, prepared by Kenyon's method (*J. C. S.*, 1922, *121*, 2540; *Organic Syntheses*, 1926, *6*, 68), were further purified by repeated distillation under reduced pressure. Density determinations were carried out using a specific gravity bottle, of capacity 30 c.c., calibrated with water, mercury, and ethyl acetate, which had been purified by standard methods, including distillation under reduced pressure. The weights used were standardised, the process of double weighing was employed, and the weighings were reduced in the usual manner to vacuum. The results for the *d*- and *l*-alcohols agreed to within one part in 10,000, the value, $d\frac{25^\circ}{4^\circ} = 0.8170$, being obtained.

This result corresponds to within one part in 10,000 with that of Picard and Kenyon for the d-alcohol (*J. C. S.*, 1911, *99*, 66). To obtain accuracy better than 1 part in 10,000, it would be necessary to know the absolute temperature of the thermostat employed to within 0.05° on the absolute scale. (See Reilly, Rae, and Wheeler, *Physico-Chemical Methods*, 1926, 299.)

THE WORK OF THE LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE.

BY MAJOR GREENWOOD, DSc., F.R.C.P., F.R.S.

Paper read before the Royal Society of Arts, April 22 (followed by a Demonstration of a Malaria Film by PROFESSOR JOHN GORDON THOMSON, M.A., M.B., Ch.B.). Dr. HENRY S. WELLCOME, F.S.A., presided.

The London School of Hygiene and Tropical Medicine was a gift of $2,000,000 from the Trustees of the Rockefeller Foundation, made to enable the University of London to carry out a recommendation of a committee presided over by the Earl of Athlone, that a centre of post-graduate training and of research in the science and art of Preventive Medicine should be established in our metropolis. The committee and our benefactors understood by the phrase Preventive Medicine something which transcended parochial or even national boundaries; they thought that Preventive Medicine should be conceived *sub specie aeternitatis*, as a universal, embracing *all* means of rendering life happier, healthier and more efficient, not in this country only, but throughout the world. Hence we have a School of Hygiene *and* Tropical Medicine, which should become the spiritual home of men and women aspiring to do their part to make the conditions of human life everywhere more bearable.

I shall not weary you with a chronological record of progress from 1899, when the London School of Tropical Medicine was founded, past the date of the incorporation of the combined school by Royal Charter in 1924, and down to the opening of the present building by His Royal Highness the Prince of Wales, on July 18, 1929. But one historical event cannot be passed over in silence; the death of our friend and leader, Sir Andrew Balfour. I have learned from and served many masters. I have known men of more commanding genius, a few as hard-working; only one as generous, as free from personal vanity, as utterly selfless as Andrew Balfour. Arthur Bacot and Andrew Balfour are names the associations of which will save the few who knew intimately the one and the many who knew the other, from harbouring mean thoughts of human nature. I shall not, I cannot, dwell upon the sensations I experience in standing here this evening in the place of a great-hearted gentleman whose

ideals we, who loved the man, must try to realise.

In the post-graduate school the line between teachers and taught, which should be faint in *all schools of university rank*, is almost evanescent. Most of us who are officially teachers have the humbling experience of trying to instruct some, at whose feet we might more properly sit. Still, there is practical convenience in even an artificial dichotomy. The staff of the School is organised in six main *Divisions*: Public Health, Biochemistry, Bacteriology, Medical Zoology, Epidemiology and Vital Statistics, Tropical Medicine. As, however, three of these divisions include autonomous departments controlled by appointed teachers of the University, Professors or Readers, the scope and independence of the responsible teachers is much wider than the mere nomenclature suggests. Again, in accordance with the practice of most University institutions, the effective research and even teaching staff is much larger than what, in the Civil Service, would be called its *establishment* suggests. Thus the scientific output of the Division of Epidemiology and Vital Statistics, indeed the necessary condition of functioning at all of that Division, requires an intimate liaison with the statistical and epidemiological work of the Medical Research Council, the Industrial Health Research Board and the Medical Department of the Ministry of Health.

The students fall into three groups. First of all a number varying between 70 and 100, came for a course of approximately six months in Tropical Medicine and Hygiene. The great majority of these students are already in or desire to enter a public medical service in the British Colonies, Dominions or in foreign countries. Their course of instruction, partly clinical, partly laboratory training, makes considerable demands upon their energy, because a great deal of ground must be covered in a short time. The next largest group consists of students mostly seeking to enter Public Health service and intending to sit for a diploma examination in Public Health of the University of London. Their course is longer, a whole academic year. A minority are not of British race. In training these students, since they are longer with us and their field is not so wide, we do not have to work under quite such high pressure and we are able to co-ordinate the teaching of different aspects of a subject more completely. It is possible, for instance, to present to the student the various aspects of a problem of disease, the chemical, bacteriological, parasitological, epidemiological and administrative sides, one after the other without undue lapse of time. Thus a sound knowledge of the general problem of, say, the prevention of plague, implies that the student is familiar with the history and present distribution of the disease, its insect porter, the biology of its *materies morbi*, and the administrative methods used for its control. The teaching of the various specialists concerned with each brand is co-ordinated.

The third group consists of students not taking a general course but specialising in one branch, and can be subdivided into those following a pre-arranged course, *e.g.*, a year's course for the Academic Diploma in Bacteriology or a three-monthly-course in Epidemiology, and those registered as candidates for a research degree of the University. This group includes some of our best students; the proportion of students not of British race amongst them is higher than in the D.P.H. class, but rather lower than in the Tropical Medicine and Hygiene class. You will gather some idea of the international scope of our work from the fact that the classes within this group of the Division of Epidemiology and Vital Statistics, which are quite small, have already included subjects of thirteen sovereign states other than Great Britain and India. Young as it is the School has already made good its footing as an international centre. Indeed, this internationalism has its humorous side. It was gratifying to my vanity a year or two ago to be able to make myself sufficiently intelligent to a small class whose international language was German, but, confronted by a zealous student from Turkey, I have had to realise that I am very far from being linguistically equipped to discharge my professorial duties. Speaking seriously, this difficulty of language is not a negligible one. An appreciable waste of time and money is involved in the resort to us of foreign students with a wholly inadequate knowledge of English. On the other hand, English students still do not sufficiently realise that a reading knowledge of the two other world-tongues, French and German, is an *essential* tool and that those who have any pretensions to become acquainted with the most important work done in tropical hygiene must add Dutch, Spanish and

Italian, rather in that order of importance, to their outfit. From what I have already said you will have gathered that the work going on covers a wide field and must needs involve the employment of highly-trained minds and costly apparatus; hence it involves the expenditure of much money. Upon the scientific work of direct importance to the manufacturer and the farmer, which is being done in the Divisions of Biochemistry, Bacteriology and Medical Zoology, I do not propose to speak. Not because this work is of little value; on the contrary it is the most immediately valuable of all the work we do for it directly concerns the processes of manufacture or the improvement of soil conditions; but because it would be unseemly for a scientific man addressing a scientific society to discuss topics of which his knowledge is at second hand. I wish to speak of matters either within my sphere of activity or in contact with it.

All enducated men have long agreed that the *hygiene* of industrial conditions must be studied. That the places in which half our poulation spend at least a quarter of their lives should be hygienic is a truism. The mere record of legislation designed to secure these conditions, would take an intelligent man some months to assimilate. But what *is* hygienic? We have all appreciated the irony of Mr. Lytton Strachey's account of the naif empiricism of Florence Nightingale's conception of hygiene. She believed in wbat she saw. She had found in Scutari that fresh air and light played an effective part in the prevention of the maladies with which she had to deal; and that was enough for her; she would not enquire furtber; what were the general principles underlying that factor—or even whether there were any—she refused to consider."

A great many people suffer from Florence Nightingale's weakness without partaking of her compensating strength. It is tbe business of a School such as ours to try to cure his defect. Our ways of thinking about the fresh air and sunlight, to which Florence Nightingale attached so much importance, have been revolutionised by a great man of our own generation, Sir Leonard Hill. Thanks to him, we know a great deal more about the principles of ventilation and the means of measuring whether ventilation is really efficient *from the point of view of the man or woman at work* than was known when Florence Nightingale died, 20 years ago; again, thanks to him, we are better able to understand and measure the virtues of sunlight from the physiological point of view than students of even less than 20 years ago. That a bit of glass tubing, which merely enables one to measure how long it takes a tube of coloured fluid to cool from 100 F. to 95 F., should be of much greater value in the practical control of atmospheric conditions than a host of elaborate and expensive machines, may seem strange to people who mistake expensive elaboration for efficiency. The point is that Hill's katathermometer does give us a measure of the way in which the human body will react to external conditions, information which can be checked against the sensations one experiences. It would be rather hard to exaggerate the increase of human comfort which the employment of this simple instrument has brought. Most of us are painfully familiar with the discrepancy between the claims made for "scientific" systems of ventilation and the results we experience, and are familiar with the psychological attitude of the experts—reminiscent of the shoe maker who practically tells us that his boots are perfect and we ought not to have such awkward feet. Hill has changed all that.

The results of Hill's investigations are important as everybody knows, but the spirit which quickened them is far more important. Less than a generation ago ventilation was believed to be primarily the business of an engineer; he was regarded as a rather unpractical person, much more interested in the twitching of frogs' muscles than the doings of men and women. The physiologist tended to despise the practical man and the practical man heartily returned the compliment. The few doctors who urged that physiology was something bigger than the technique of university laboratories were mostly amateurs whom the *pukka* physiologists, often enough quite rightly, declined to take seriously as scientific men at all. Leonard Hill has done far more than any other man to exorcise that evil spirit of intellectual snobbishness. Long before he expressly directed his energies to the physiology of industry, or human life as a whole, he preached a new doctrine. It is more than thirty years since I came under his influence, an influence which, like that of all very great men working upon impressionable youths, changed my whole scale of values. None of Hill's students or demonstrators could fail to realise that

laboratory physiology was not an end in itself but a tool, a tool not to be despised or neglected—we were *not* encouraged to believe that slovenly technique in the making of nerve-muscle preparations was an indication of large-mindedness, we *were* privileged to watch a master of that technique at work—but *only* a tool, and that the proper ambition of a physiologist was to understand human physiology. For the first time a man who had done far more than win his spurs in what was regarded as the legitimate field of the academic physiologist came into the workshop; refused to be roped off in a laboratory and treated as an academic consultant, whose advice could be taken or ignored as the practical man pleased, determined to meet these practical men on equal terms, not disdaining to learn how life was actually lived.

Leonard Hill has been the real founder of applied physiology in England, and it is the business of such a School as that in Keppel Street to see that the liaison he established between the laboratory and the workshop shall never be broken. It is true that the number of trained investigators is still small, but at least there are some, and thanks to the co-ordination of our work with that of the Industrial Health Research Board, the number will increase. The organisation of the Medical Research Council has developed the co-operation of academic physiologists and the staffs of industrial organisations so that joint work is possible in other branches of physiology than those with which Leonard Hill's name has been associated. In particular, the physiology of the special sense organs is now receiving adequate attention. A School such as ours, with its ample laboratory accommodation and its intimate relations with the public health and industrial medical services, is becoming a focal point, and upon our policy the future of applied physiology in England may largely depend. One element of success we have already secured. Unless the entrants to the Public Health Services receive a proper grounding in the applications of physiology, there can be no progress. It is important to secure trained investigators, it is even more important to be sure that the medical administrators of the future shall have a sympathetic appreciation of what these investigators can do.

During the war I was a member of a scientific advisory committee of the Royal Air Force, by virtue of having some knowledge of statistical methods in their application to problems of physiology. There, for the first time, I had to realise in practice that physiology led on to psychology. Another and quite different piece of war work—the study of accidents in shell factories—brought me up against the same—as it then seemed—dead end. For, while by 1918 applied physiology had already its Leonard Hill, psychology seemed, to a more or less intelligent outsider like me, either narrowly academic or a mere inferno of apparently very angry people shouting at one another. If it cannot be said that applied physiology has even now found a Leonard Hill it can most certainly be said that in the last 13 years a great change has come over the scene. Thanks largely to the prescience of its first secretary, Mr. D. R. Wilson, the Industrial Health Board realised from the beginning that the psychological aspects of industrial hygiene were of importance at least equal to the physiological aspects. The Board's reports on the causation of industrial accidents, on the ætiology of Telegraphist's cramp and, quite recently, on the nervous temperament, can leave no doubt of the value of what has already been done and of the importance of what remains to be done.

We know that a great deal of the ill-health and worry which poison the happiness and restrict the efficiency of a too large proportion of men and women in industry is of psychological origin. We know that whether a person whose nervous make-up departs from the normal shall be able to lead a happy and efficient life is a question which can be answered, *not* with perfect confidence, but with fair accuracy, after skilled examination of the individual *and* his environment. A few years ago what was called psychology became a popular stunt. Some of the ideas of a very great man, Freud, inaccurately described by A to B, passed on by B toC and circulated around the whole alphabet of ignorantly inquisitive readers and talkers, flooded the newspapers, and all the world chattered about complexes and psycho-analysis. Investigators have had to try to solve the following problem. Given that a great deal of inefficiency and ill-health are due to non-bodily causes, to " nerves," or " vapours " as one would have said in the 18th century: (1) It is possible by clinical examination and laboratory testing to classify the " nervous " types of the population at work. (2) Do the resultant classifications

show substantial correlation with performance in or adaption to actual industrial conditions. This problem has been in so far solved that, as shown in recent reports of the Industrial Health Research Board, methods of examination have been perfected which enable us to correlate psychological type with effective performance. In particular cases the judgment may be hopelessly at fault, but the statistical, the average, result of assessing the psychology elements of an industrial situation has been proved to be highly relevant to such issues as that of service efficiency.

The Industrial Health Board have devised a combination of clinical and experimental methods of research which is, I think, unique and holds out hopes of advantages hard to exaggerate.

The part the School of Hygiene and Tropical Medicine is playing in this revolution is large. From the educational point of view we have had to go further than was necessary in physiology. All medical students have at least received a training in laboratory physiology. No medical students have been trained at all in psychology of any kind, laboratory of clinical. A beginning was made last year at the School by introducing the elements of clinical psychology into the D.P.H. curriculum; but we have not been content with this modest instalment of reform. In addition to the regular course students, we have been met with the demands of individuals either already in the industrial medical service or intending to enter it, who desired to do post-graduate work. We have found that the problems they proposed nearly always had a psychological aspect. Usually they have come, in the first instance, to the Division of Epidemiology and Vital Statistics, because their problems looked statistical—for instance, a comparative study of time lost by sickness in different departments of a retail house—but it has been obvious that much more than statistical *expertise* was required to bring their investigation out of the region of mere paper science. Hence, there has been the need of higher teaching in psychology. Other institutions of university rank readily co-operate with us, but we realised that, although general and experimental psychology were quite adequately provided for, the more purely medical aspects of the subject could only be covered by a teacher of special experience. Hence the Senate has been moved to establish a Chair of Medical and Industrial Psychology in the School.

COMETS AND SHOOTING STARS.

Lecture by Sir Richard Gregory before the Gilbert White Fellowship, April 11.

Sir Richard Gregory in his lecture at the annual meeting of the Gilbert White Fellowship referred in detail to meteors and meteorites. He pointed out that the total weight of the great meteorite which fell in Siberia, probably the largest which has struck the earth in historic times, must have been thousands of tons. If this mass had fallen upon London instead of upon a Siberian forest, the destruction and death due to it would have been too awful to contemplate.

The blast of air produced by the metorite devastated the forests over an enormous area. At the nearest settlement, fifty miles away, people were scorched by the heat, and houses were damaged. On the site of the fall the trees over a large area, as well as a herd of some 1,500 domesticated reindeer, were destroyed.

On the average only three or four brilliant comets appeared in a century, but many more were observed telescopically, and scarcely a year passed without half-a-dozen being discovered. Many comets attained enormous dimensions. Thus the great comet of 1858 had a head a quarter of a million miles in diameter, while its tail was more than 50 million miles in length. Yet a hundred thousand of the largest comets ever observed would not weigh as much as the earth. Their density would be thousands of times less than the density of the ordinary air. The head, however, was probably composed of a large number of small but solid bodies and the earth had on more than one occasion passed through the tail of a comet without any marked effect being observed.

It was difficult to say what would be the result of running full tilt into a comet's nucleus. If the nucleus consisted merely of " cosmic dust," only a brilliant shower of shooting stars would be seen, but if it was made up of bodies as large as or larger than cannon-balls the consequences would be serious. Myriads of the meteoric masses would beat upon the earth and the burning of their materials would probably use up the oxygen in the atmosphere, in which case man and all the animal creation would perish. The temperature of the air would be raised to such a degree that all vegetation would be destroyed and the world transformed into a desolate and barren rock.

The word "star" when applied to such a transient object as a shooting star or meteor was a libel upon the mighty suns fervidly shining in infinite space. Shooting stars were small particles of matter revolving round the sun like the earth. The latter was constantly meeting these specks of cosmic dust and attracting them towards itself. The consequence was that they entered the earth's atmosphere at about thirty miles a second. As a rifle bullet, travelling much slower, became hot in passing through the air it was easy to understand that a particle entering the earth's atmosphere at the terrific speed of thirty miles a second must become very hot by friction against it. The heat developed was sufficient to melt and vaporise the solid particle and its dissipation in this manner produced the phenomenon of the shooting star. Something like four hundred millions of solid particles, each weighing only a few grains, rained down upon the earth and were consumed in the atmosphere daily.

The difference between meteors and fireballs was probably only one of size. Some meteor were so large that they reached the earth's surface before sufficient heat had been developed to drive them entirely into vapour, and those which penetrated the torpedo net of earth's atmosphere were known as meteorites.

CANADA'S NICKEL AND PLATINUM PRODUCTION.

The Dominion Bureau of Statistics at Ottawa reports that Canada's nickel output last year was slightly under that for 1929. The International Nickel Company continued to produce electrolytic nickel at Port Colborne, Ontario; some matte was despatched to Huntingdon, Va, for the manufacture of monel metal, and some was exported to Clydach, Wales, for refining. The smelter matte from the Falconbridge mine was shipped to Norway.

All the Canadian platinum and allied metals are obtained from the treatment of the Sudbury nickel-copper matte, with the exception of a few ounces of platinum obtained from the black sands of British Columbia, and a small quantity produced as an impure residue in the refining of gold at Trail, British Columbia.

PATENTS AND DESIGNS ACTS AND PRACTICE OF THE PATENT OFFICE.

Committee's Report.

The Board of Trade announce that the Report or the Departmental Committee on the Patents and Designs Acts and practice of the Patent Office has been published (Cm. 3829), and that copies may be obtained from H.M. Stationery Office, or through any bookseller, price 1s. 6d. The minutest of evidence taken before the Committee will be published in the course of the next few weeks.

The Committee was appointed by the Board of Trade in May, 1929, to consider and report whether any, and if so what, amendments in the Patents and Designs Acts, or changes in the practice of the Patent Office are desirable. Its membership was as follows:—The Rt. Hon. Sir Charles Sargant (Chairman), Mr. H. Ballantyne, Mr. H. A. Gill, Mr. E. H. Hodgson, C.B., O.B.E., Sir Herbert Jackson, K.B.E., F.R.S., Sir William Jarratt, Mr. Fearnley Owen, Mr. J. G. Weir, C.M.G., C.B.E., and Mr. J. Whitehead, K.C.

The Report of the Committee is divided into three parts, (I) Patents, (II) Designs and (III) General, and contains a summary of the Committee's main recommendations.

Inventions Relating to Chemistry, Medicine and Food.

The Committee recommend an amendment of Section 38a (1) in order to remove a grievance which exists among inventors in the fields of chemistry, medicine and food, that invention in this class of subject-matter is being unduly hampered by reason of the interpretation placed upon the said sub-section in a Judgment of the Law Officer (given in 1922) on appeal from the Comptroller.

Before 1919 no restrictions whatever were placed on the patenting in this country of chemical products or of substances intended for food or medicine, although the laws of most foreign countries prohibited the grant of patent in these cases. The question of the validity of claims to chemical products (apart from the actual processes of manufacture) was very doubtful the weight of authority being against the validity of such claims, but the point was never definitely decided by the Courts.

During the war the question arose in an acute form, owing to the lack of dyestuffs

in this country. Under war-time legislation, a large number of licences to work German-owned patents were applied for, and the necessarily close scrutiny given to the specifications of such patents disclosed the fact that many contained claims to chemical products apart from the processes of manufacture described.

In this state of things, it was decided in 1919 to bring the British Law into agreement with many foreign laws and to restrict the claims in the specifications of patents in respect of chemical products or substances intended for food or medicine to the process disclosed in the specification, and to refuse product claims except where the substances was prepared or produced by the "*special* methods or processes of manufacture described and claimed." And by Section 38a (1) of the Patents Act of 1919 it was so enacted.

The evidence before the Committee was that, although the provisions of Section 38a (1) had been of considerable value in encouraging the development of British chemical industry, difficulties had arisen by reason of a decision given by the Law Officer on the word "*special*" and invention in this field was being severely hampered. It was suggested, therefore, that the word should be excised, or replaced by the word "particular."

The Committee recommend the adoption of the latter suggestion, but in order to effect a compromise between two objects, (1) of avoiding the encouragement of futile claims in relation to food and medicine, and (2) of not unduly hampering invention with regard to this subject-matter, recommend the addition of a proviso to the sub-section to the effect that in respect of substances intended for food or medicine, a mere admixture resulting only in an aggregation of the known properties of the respective ingredients shall not be deemed to be a *particular* process of manufacture.

GRAPHITE IN CANADA.

Graphite in found in Canada in the provinces of Ontario, Quebec, New Brunswick, Nova Scotia, and British Columbia, and in the northern parts of Canada, in the Northwest Territories and on Baffin island. Nearly all the production, however, comes from Ontario and Quebec, where graphite has been mined for more than sixty years, most of the producing mines and all of the graphite concentrating mills being situated within a radius of 150 miles of Ottawa.

GENERAL NOTES

The April 12 issue of the *Prager Presse*, one of the leading Czechoslovak newspapers published in the German language, is a special number in commemoration of the ten years of its publication. It comprises 120 pages, including a 52 page illustrated supplement and contains a number of special articles dealing with the influence of the press upon Education, Literature, Science and Art. There are also contributions on the development of wireless, railways and industrial undertakings with special reference to the ten years under review. One of the most informative articles is by Dr. R. Rolicek who describes the products obtainable from the fermentation of molasses (the sugar beet industry is highly developed in Czechoslovakia although undergoing a difficult time at the moment). These include pure and industrial alcohol, fusel oil for use in the chemical industries, potash for glass, textile and dyeing industries, ammonium sulphate and fertilisers, sodium cyanide for extracting gold at the Kremnica mines in Slovakia, and for electroplating processes, and charcoal.

Among the illustrations are pictures of the new analytical and other laboratories at the Masaryk University at Brno, new schools in various parts of the republic, recently constructed roads, bridges, model dwellings, electricity undertakings and views of the various curative spas, Danube docks, etc.

The regular features of the *Prager Presse* include daily columns dealing with Music and Plays, Art, Literature, Science, Visitors' Guide, Financial Industrial and Commerical pages, etc. There are also weekly surveys of foreign and Czechoslovak politics, Literary, Travel and Illustrated supplements which go to show that the *Prager Presse* attains a high level among contemporary journals.

This special issue also includes a number of pictures of the buildings, presses and departments of "Orbis," the printing and publishing house which, in addition to the *Prager Presse* also issues a number of important periodicals in both Czechoslovak and foreign languages. Among the former is the official broadcasting weekly, *Radio Journal*, whilst those in languages other than Czech are *L'Europe Centrale* and the *Central Europe Observer* (weeklies) and a monthly review in Russian.

The *Central European Observer* (price 2 crowns or 5d.; annual subscription 15s.) resembles in appearance and "get-up" the English weekly journals and is devoted to a review of events, politics, literature, science art and industry. Both in articles and in style and printing it maintains a high standard as, indeed, do all the publications (books and periodicals) issued by "Orbis."

NEW CANADIAN SOURCES OF PRECIOUS METALS.

On April 23 Acton was the scene of an Empire Trade Gathering which emphasised the enormous wealth in precious metals of the British Empire and especially of Canada.

The occasion was the opening of the extensions to the Acton Precious Metals Refinery, the most important of its kind in the world. The opening ceremony was followed by a luncheon at which Lord Weir presided over a very distinguished attendance. The Government was represented by the Rt. Hon. J. H. Thomas, Secretary of State for the Dominions, and the Dominion of Canada by the Hon. G. H. Ferguson, High Commissioner. Industry was represented by Sir Harry McGowan, Chairman of Imperial Chemical Industries, Mr. R. C. Stanley, President of the International Nickel Company of Canada and Mr. D. O. Evans; and Science by Sir Harold Carpenter, Professor of Metallurgy, Royal School of Mines, Dr. Rosenhain, of the National Physical Laboratory, and Dr. F. W. Smith, Chief Assayer of the Royal Mint.

The extensions to the Refinery have been necessitated by the enormous new supplies of what are known as the "platinum metals," which have been developed recently in the nickel copper ore region of Ontario. When the Refinery was first opened in 1924 its capacity was 40,000 ounces a year, whereas with the opening of the extensions, its capacity will be 300,000 ounces. Since the total world consumption is under 400,000 ounces per annum, Acton will be able to refine from Empire sources three-quarters of the world's demand.

The platinum metals, which are very rare and little known to the general public, include platinum, palladium, iridium, rhodium, ruthenium and osmium.

Not only does Canada now supply such a huge share of the world's output of these metals, but supplies them as by-products of the metals nickel and copper. The base metals from the ores mined in Ontario are extracted either at Port Colborne in Canada or at Clydach in South Wales. The "concentrates" containing the precious metals are sent eventually to Acton in quantities sufficient to allow the highly scientific methods of the laboratory to be applied on a production scale.

Uses of Platinum Metals.—The announcement of the extensions to the Acton Precious Metals Refinery is a snrprising proof of the predominance of Canada in the output of a group of precious metals, the supply of which has been associated usually with Russian or South American sources.

Until fairly recently platinnm was found exclusively in sands and gravels chiefly in the Urals or Columbia, but the recent development of the extraordinarily rich metal-bearing district of Sudbury, Ontario, has made available in large quntities the complete group of platinum metals.

These greatly increased supplies will mean that it will be possible to put the metals to uses for which they are ideally suited bnt from which their scarcity rather than their high price has debarred them hitherto. Until recently rhodium and ruthenium, for example, have been little more than curiosities of the chemical laboratory. Platinum is the most important of the group, both in quantity and in usefulness. Not only is it one of the most satisfactory and beautiful settings for precious stones and for all sorts of uses in jewellery, but it is of the first importance to the dentist, the surgeon and still more to industry. The artificial silk industry, especially, uses large quantities of platinum or palladium alloyed with gold for the little spinning jets which are the heart of the manufacturing process. Platinum is universally used in science rooms and laboratories, and during the War the huge consumption of the metal for the fuse wires for detonating caps sent the price up enormously.

One of the greatest potential uses of palladium is for dental alloys, since by reflecting the colour of the gums and oral tissues, the plates are practically invisible in the mouth. Another important development is palladium plating. For example, silver treated with palladium will not require polishing, while all reflecting surfaces will benefit from similar treatment.

Platinum was discovered as far back as 1750, the last of the group, ruthenium, no more recently than 1845.

PROPOSED NEW CALENDAR.

The World Calendar Association of New York, is pressing for a change in the present method of dividing the year. It is pointed out that many disadvantages accrue from the irregular length of the twelve months, a legacy from the mutilated calendar of Julius Cæsar. The present Gregorian calendar, adopted in 1582 by Catholic countries and more generally accepted by the Western World in 1752, has many annoying irregularities and several proposals have been suggested for reforming it. These have recently been considered by various governments (notably that of the U.S.A.) and by the League of Nations and whilst some change would be welcomed nothing definite has yet been agreed upon. On the one hand an International Fixed Calendar of 13 months has been advocated in which a new month, Sol, would be inserted between June and July, each month having 28 days and each quarter being 3¼ months. December 29 would be called Year Day and the odd day of leap years would be June 29.

The World Calendar, another proposal, proposes to start each year on a Sunday, leave 12 months to the year, giving January, April, July and October, 31 days and the others 30 with a second Saturday after December 30. Leap day would form a secoud Saturday after June 30.

It will be recalled that Russia has recently introduced a new calendar based upon a five-day week, so that whilst change is perhaps desirable, confusion may well result from further alterations.

LEAD AND ZINC DEPOSITS IN CANADA.

At the second and third Empire Mining and Metallurgical Congresses held in Canada and South Africa respectively in 1927 and 1930, resolutions were passed pointing out the necessity of bringing together in every part of the Empire the available information relative to mineral resources, existing developments, smelting and refining facilities, etc., in order that governmental and industrial leaders might at any time be in the possession of facts essential in the formulation of Imperial policies. These resolutions have recently been considered by the Imperial Conference in London and the desirability of measures to obtain information as to mineral resources has been emphasized.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

January 28, 1931.

Practical investigations on the earth resistivity method of geophysical surveying. By G. F. Tagg, B.Sc., A.M.I.E.E.

The paper deals with the methods of geophysical survey which depend on the measurement of the electrical resistivity of the earth. The theory is explained for the case of a single horizontal stratum, and pratical tests are described and discussed.

March 6, 1931.

A Photoelectric Spectrophometer for Measuring the Amount of Atmospheric Ozone. By G. M. B. Dobson, D.Sc., F.R.S.

A special instrument is described in detail which has been designed in order to allow measurements of the amount of ozone in the atmosphere to be made easily and rapidly under nearly all conditions. The instrument follows the usual practice of measuring the absorption by the ozone of solar ultra-violet energy; from this measurement the amount of ozone can be deduced. A double quartz monochromator isolates certain pairs of wave-lengths, and the relative energy in the two wave-lengths of a pair is measured by allowing them to fall alternately on to a photoelectric cell, the current from which is amplified by thermionic valves. This allows great sensitivity to be obtained so that very small amounts of light can be accurately measured. For measuring the amount of ozone a pair of wave-lengths, one of which is strongly absorbed by ozone while the other is not, is selected. It is shown how the amount of ozone can still be measured when the sky is cloudy if a second pair of wave-lengths, both unabsorbed by ozone, be also measured. The results of tests which show that the accuracy is ample for meteorological requirements are given.

April 17, 1931.

The following papers were read :—

The Generation of Current-Pulses of Rectangular Wave-Form. By A. J. Maddock, M.Sc., A.Inst.P.

A circuit for the production of single current-pulses or for use as a heavy-duty time switch is described in which there is practically no limit to current-carrying capacity. Such pulses of current can be obtained when desired by the simple depression of a key. It is shown that two distinct wave-shapes are available in different

branches of the circuit and that by suitable choice of inductance, resistance and capacity the current time wave in one branch should be of rectangular form. Two separate timing-circuits are described, one for periods up to about 2×10^{-2}sec. and the other for use up to 16 sec. or longer. Suggested uses and extensions of the circuit are given.

Edge Tones. By E. G. RICHARDSON, B.A., Ph.D., D.Sc.

If a fluid leaves an orifice as a jet and strikes an edge, two vortex streets are formed on each side of the wake, and maintain the jet in pendulation at a definite frequency. The tones so produced are examined from theoretical and experimental standpoints, and relations connecting the frequency with (*a*) velocity, (*b*) distance from orifice to edge, (*c*) width of orifice, (*d*) for of the orifice, are tested. It is shown that all the features of the phenomena can be explained in terms of the hydrodynamics of a viscous fluid, without postulating compressibility in addition.

ROYAL AGRICULTURAL SOCIETY.

April 1.

Mr. Fred Smith (Chairman) reported to the Chemical Committee that the list of samples analysed for members by the Consulting Chemist during the months of February and March had been submitted to the Committee. Dr. Voelcker had reported that, following the recent agitation regarding the purity of barley meal, the traders had come to an agreement as to the standard which should be fixed for "Persian" barley. The Committee had received this intimation with satisfaction.

Dr. Voelcker had drawn attention to the recurrence recently of Chilean peas on the feeding stuffs market. A member of the Society submitted a sample for Dr. Voelcker's opinion, and these, like those previously reported upon, were found to be cyano-genetic, or of a prussic acid forming nature. It was desirable again to put purchasers of feeding stuffs for stock on their guard against these.

Mr. Fred Smith, in moving the adoption of the report, was sure that the Council would wish to congratulate Dr. Voelcker on his recovery from his recent illness. He was sure that everyone hoped that Dr. Voelcker had before him many years of work for the good of agriculture.

The report was adopted.

NOTICES OF BOOKS.

SCIENCE AND BEAUTY CULTURE.

The Cream of Beauty. By H. STANLEY REDGROVE, B.Sc., A.I.C. Pp. xii + 184. London: Messrs. Heinemann (Medical Books), 99, Great Russell Street, W.C. 1931. Price 5s.

Mr. H. S. Redgrove has written, during the last few years, several scientific works which serve the double purpose of reviewing and summarising recent developments in the perfume and allied branches of applied chemistry and in acquainting the general public with the subject from a correct scientific standpoint. Thus, his very attractive book, *Scent and All About It* (*Heinemann*, 3s. 6d.) described the origin, nature and modes of preparation of the perfumes, together with the art of their application. Now he has written a plainly worded, practical and invaluable book on Beauty Culture.

The topics discussed include the care of the face, the teeth, the hands, the feet, the hair and the body generally, including *la toilette intime*. The composition and uses of various toilet and beauty preparations are simply explained. Those considered include all types of "creams," manicure preparations, mud packs, face-powders, lip-sticks, toilet lotions, hair washes, tonics, depilatories, etc. Recipes and instruetions for the preparation of many of these are also given.

Mr. Redgrove insists that the secret of beauty lies in good health, the application of perfnmes and cosmetics can, however with advantage be employed to enhance and supplement natural beauty. On the other hand, he has some strong things to say concerning the vogue of attempting to remove "superfluous" hair. He also insists that medical advice should always be sought before any attempt is made to remedy any bodily disfigurement or defect however trivial this may appear to be.

The *Cream of Beauty* will appeal in the first place to those who wish to give the finishing touches to their natural attractions It should be read equally by chemists analysts and others interested in the nature composition, uses and functions of the ever increasing number of beauty preparations

OFFICIAL PUBLICATIONS RECEIVED.

UNITED STATES DEPARTMENT OF AGRICULTURE. WASHINGTON D.C.

Survey of the Fertilizer Industry. By P. E. Howard. Circular No. 129. Price 5 Cents.

Character of the Colloidal Materials in the Profiles of Certain Major Soil Groups. By M. S. Anderson. Technical Bulletin No. 228. Price 5 Cents.

Variations of the Colloidal Material Extracted from the Soils of the Miami, Chester, and Cecil Series. By R. S. Holmes. Technical Bulletin No. 299. Price 5 Cents.

CANADA—DEPARTMENT OF TRADE AND COMMERCE.

Dominion Bureau of Statistics, Mining, Metallurgical and Chemical Branch.

Preliminary Report on the Mineral Production of Canada, 1930.

Forthcoming Events.

APRIL 24.

ROYAL INSTITUTION, 21, Albemarle Street, W.1., at 9 p.m. "John Priestly, and His Place in the History of Science." By Sir Phillip Hartog.

APRIL 27.

ROYAL SOCIETY OF ARTS, John Street, Adelphi, W.C.2., at 8 p.m. Howard Lecture. "The Present Position in Aeronautics." By N. A. V. Piercy, D.Sc. (Lecture III).

APRIL 29.

ROYAL SOCIETY OF ARTS, John Street, Adelphi, W.C.2., at 8 p.m. "Stainless Steels." By Sir Harold Carpenter, F.R.S.

MAY 1.

ROYAL INSTITUTION, 21, Albemarle Street, W.1., at 9 p.m. "Charlotte Bronte in Brussels." By Professor D'Arcy W. Thompson, C.B., D.Litt., F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS. Meter and Instrument Section. Savoy Place, Victoria Embankment, W.C.2., at 6 p.m. "High Voltage Precision Measurements." By Professor W. M. Thornton.

THE PHYSICAL SOCIETY at the Imperial College of Science, Imperial Institute Road, Sounth Kensington, at 5 p.m. Ordinary Meeting.

MAY 6.

INSTITUTE OF METALS. General Meeting. Institution of Mechanical Engineers, Storey's Gate, S.W.1., at 8 p.m. Twenty first Annual May Lecture on "Progress of Power Production." By W. B. Woodhouse.

ROYAL SOCIETY OF ARTS, at 8 p.m. Ordinary Meeting. "Preservation of the Countryside." By Major-General Sir Fabian A. G. Ware, K.C.V.O., K.B.E., C.B., C.M.G., LL.D.

SOCIETY OF PUBLIC ANALYSTS, Burlington House, Piccadilly, W.1., at 8 p.m.

MAY 7.

CHEMICAL SOCIETY. Ordinary Scientific Meeting. Burlington House, Piccadilly, W.1., at 8 p.m.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

9,602.—Imperial Chemical Industiials, Ltd., Thomas, J. and Loveluck, R. J.—Production of amino-anthraquinone derivatives. March 30.

Specifications Published .

345,650.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production o halongenated 3.4.8.9-dibenzopyrene-5.10 quinones.

345,662.—Montecatini Soc. Generale Pe L'Industria Mineraria Ed Agricola —Manufacture of concentrate nitric acid.

Abstract Published.

340,656.—Alcohols. Natta, G., 19, Vi Rugabella, Milan, Italy.

Ethanol and higher alcohols are produce from mixtures of carbon monoxide an hydrogen, under pressure, with or withou

the addition of methanol, employing as *catalysts* alkali salts of fatty acids mixed with porous supports, for instance, zinc oxide, pumice, magnesite, silica or such as may be employed as catalysts for the synthesis of methanol, for instance, calcined Smithsonite. Formates, acetates or propionates of potassium, rubidium or caesium, or mixtures thereof, are specified. A temperature of 400°-420° C. and pressure of 250-300 atmospheres may be used. Carbon dioxide produced is removed from the reaction gases by washing with alcohol, for instance, synthetic methanol. An initial mixture of more than two volumes hydrogen to one volume carbon monoxide may be used, but the gases returned to the cycle after washing may contain a smaller proportion of hydrogen. To prevent decomposition of the catalyst, the pressure is increased prior to the increase in temperature. Specification 330,919, (*Class* 2, iii, Dyes etc.), is referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ALBATEX.

520,771.—Chemical substances for use in the manufacture of textile fabrics. —Society of Chemical Industry in Basle, 141 to 227, Klybeckstrasse, Basle, Switzerland. April 8.

SIRIAL.

520,569.—Chemical substances for steeping colouring and brightening textile fabrics and leather in the course of manufacture, but not including coal tar colours.—H. Th. Bohme Aktien-Gesellschaft, 29, Moritzstrasse, Chemnitz, Germany. April 8 (By Consent).

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or How to Reason Correctly. By J. E. Roscoe, M.A., Oxon.

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THE ESSENTIAL OIL OF TAIWANIA CEDAR.

By KINZO KAFUKU AND RYO KATO.

The Taiwania cedar is one of the five big conifers indigenous to Formosa and is found along the central mountain range at an altitude of 6,000 to 7,000 ft. above sea level. It closely resembles Japanese Cryptomeria cedar (*Cryptomeria japonica*, D. Don.) in appearance, hence its Latin name —*Taiwania Cryptomerioides*, Hayata. Its essential oil has hitherto never been studied but as it has a peculiar pleasant smell of its own, the authors undertook to investigate the nature of its volatile constituents, if any.

The material for examination forwarded by the Forestry Department at Taiheizan (Mt. Taihei) represented several root-stumps of a big, freshly hewn tree, of about 100 years of age, and they were chopped into small pieces of 1 × 3 × 8 × cm. in size, and put into a still. On prolonged steam distillation the authors obtained a very viscous oil of faintly yellow tinge with characteristic pleasant aroma, the yield amounting to 0.23 per cent. by weight of the material used. The oil, though very viscid, showed no tendency to deposit solid crystalline substance even on cooling with freezing mixtures. On fractional distillation it gave no terpene or terpene alcohol fractions, but seemed to consist practically of sesquiterpenes and sesquiterpene alcohols—*viz.*, about 34 per cent. cadinene, 2-3 per cent. humulene and caryophyllene, and 46 per cent. sesquiterpene alcohol. This last mentioned sesquiterpene alcohol closely resembled that isolated by L. Ruzicka from West Indian sandalwood oil, in such respects as, the boiling point, the formation of hydrochloride, inaction towards phthallic anhydride, etc., etc. Thus, it is of interest whether this oil can be used or not as a substitute for the aforesaid oil for therapeutic purposes as a drug.

EXPERIMENTAL.

The oil directly after steam distillation, on being dried over anhydrous sodium sulphate, showed the following constants:—

d^{15}_{4}	0.9593
$n^{15}D$	1.5104
$\alpha^{21}D$	-2.00°
Acid value	0.38
Ester value	10.52
Do. after acetylation ...	83.00
Specific viscosity	137.1
Turbidity number (alcohol)	7.5

On shaking the oil with 40 per cent. sodium bisulphite solution, no formation of crystalline precipitate was observed, from this it follows likely that the oil contained neither aldehyde nor ketone. The result of five consecutive fractional distillations with Widmer's dephlegmator, is shown below.

Fraction	Boiling point °	Pressure	Distillate %
(1)	113—115	10mm.	0.28
(2)	115—120	,,	0.16
(3)	120—125	,,	1.13
(4)	125—130	,,	2.06
(5)	130—133	,,	21.00
(6)	133—135	,,	13.70
(7)	135—140	,,	0.49
(8)	140—145	,,	1.23
(9)	145—150	6mm.	46.20

The properties of these fractions are :—

	d	n	α	M.R.
(1)	0.9104	1.4913	− 5.40°	—
(2)	0.9097	1.4979	− 1.40°	—
(3)	0.9089	1.5002	+ 1.08°	66.04 as $C_{15}H_{24}$
(4)	0.9134	1.5050	+ 7.20°	66.24
(5)	0.9189	1.5090	+35.20°	66.30
(6)	0.9215	1.5110	+54.60°	66.36
(7)	0.9641	1.5110	− 17.40°	—
(8)	0.9715	1.5104	− 33.40°	—
(9)	0.9742	1.5093	− 40.46°	68.01 as $C_{15}H_{26}O$

It is noteworthy that the first two fractions and the last three are laevo-rotatory, while the rest are all dextro-rotatory, and that the fraction (5) which forms the greater part of the sesquiterpene fraction still contains oxygen to an extent of 2.6 per cent., while the next (6) is practically pure hydrocarbon. From these, it follows that there may be a certain oxygenous compound of laevo rotatory nature in the lower boiling portions. Whether this oxygenous compound be of terpenic alcoholic nature or not, we leave it for the future to decide.

The Sesquiterpenes. — From considerations on the boiling behaviour and other physical constants, it seemed most probable that the fractions (3), (4), (5), and (6) consisted for the most part of dicyclic sesquiterpenes, so that the authors tested for the presence of caryophyllene and humulene with the fractions (3) and (4), and of cadinene with (5) and (6).

Thus, 0.5 gr. each of (3) and (4), was dissolved in an equal volume of absolute ether, and a dry current of nitrosyl chloride was passed in the cold as suggested by Ehestädt, and stood overnight in the ice chamber, then ether expelled and treated with methyl alcohol, when, an amount of crystalline substance separated out. Then it was fractionally recrystallised from methyl alcoholic solution and the resulting nitrosochloride tested for the melting point.

It was found that the nitrosochloride from (3) melted at 165°-166°, while that from (4) at 105°-106°. That the former was identical with humulene nitrosochloride, could be proved by the unlowering of its melting point on admixture with humulene nitrosochloride from oil of *Chamaecyparis Obtusa*, Sieb. et. Zucc., but the latter, on examination, seemed likely to be a mixture of cadinene nitrosochloride with some other higher-melting nitrosochloride.

Thus, they were once more fractionated under 10 mm. pressure, and it was possible to separate them into a lower boiling inactive, and a higher boiling active fractions. These afforded on treatment with nitrosyl chloride following Ehestädt's method, two nitrosochlorides, the one melting at 165°-166°, and the other at 175°. The former was of course identical with humulene nitrosochloride, and the latter proved to be that of caryophyllene, which identity was affirmed by observing the mixed melting point with a known sample of caryophyllene nitrosochloride from Chamaecyparis oil. This latter nitrosochloride with m.p. 175°, showed an optical activity of +3.82° (0.423 gr. in 10 c.c. of chloroform).

Next an attempt was made to prepare nitrosites but it was altogether fruitless, and no crystalline substance could be obtained. But the action of cold glacial acetic acid solution of nitric acid on a mixture of 2 c.c. each of the sesquiterpene, isoamyl nitrite, and glacial acetic acid, afforded crystalline nitrosates from both, which after recrystallisation from methyl alcohol, melted both at 162° and was proved to be humulene nitrosate (mischproben).

The fraction (5) was boiled over metallic sodium for six hours to get rid of oxygenous substances, and then rectified in vacuo, and in this way, a rather pure product was obtained.

On Liebermann's colour test, the hydrocarbon produced indigo blue colour which gradually turned into blue and then pink. If dissolved in chloroform and a drop of concentrated sulphuric acid added, it imparted to the solution a deep red coloration. This agrees with the behaviours of cadinene, so that tests in this direction were carried

out. One gram of the sample was dissolved in an equal amount of absolute ether, and a current of dry hydrogen chloride gas was passed into the ice-cold solution, after twenty minutes an amount of crystals separated out which was kept overnight, then ether and hydrogen chloride driven off in vacuo, and the resulting semisolid mass was thoroughly washed with cold glacial acetic acid and then recrystallised from acetic ether. The while needle crystal thus obtained melted at 117-8° C., identical with cadinene dihydrochloride.

The nitrosate and the hydrobromide were prepared in the usual manner and after due purifications melted at 110°-111° and 124°-125° respectively, which is in accordance with the data for the corresponding derivatives of cadinene. The fraction (6) had practically the same constants as this rectified product from (5). It is worth mentioning, that in the second experiment, the hydrochloride (m.p. 117°-118°) offered an optical activity of −39.64° (in chloroform solution), and that the cadinene regenerated from this hydrochloride rotated a laevo-rotation of −47.42°, whereas the original sesquiterpene gave a rotatory power +56.60°. This is in accordance with the description by Semmler that the hydrochloride obtained either from *d*- or *l*-cadinene, as well as the revived cadinene from the hydrochloride are all laevo-rotatory.

No crystalline compound other than carinene glycol has been obtained. The authors oxidised cadinene with acetone permanganate and obtained a substance melting at 142° 143° with a composition corresponding to the formula $C_{12}H_{22}O_2$. It was carried out in the following manner. To a mixture of 20 gr. of the rectified hydrocarbon from (6), 150 gr. of acetone, and 40 gr. of water under stirring, 20 gr. of finely powdered potassium permanganate was added in small portions and the temperature maintained at 30°-40° during the reaction. After the reaction was over, the mass was subjected to steam distillation to drive off acetone and unacted hydrocarbon, then the residue was extracted with ether. The ether extract was evaporated and distilled in vacuo, when 12gr. of unacted cadinene came over, and then about 4 gr. of higher-boiling oxidation product distilled at about 140° under 4 mm. pressure. This product was treated with petroleum ether when a crystalline substance deposited which melted at 142°-143° after purification. The substance, on analysis, showed the composition $C_{12}H_{22}O_2$.

The Sesquiterpene Alcohol.—The fraction (9) practically consisted of sesquiterpene alcohol, $C_{15}H_{26}O$.

This fraction, on Liebermann's test, gave indigo blue colour at first which faded into pink, while the chloroformic solution, on addition of a few drops of concentrated sulphuric acid, turned into dark blue and changed into red in course of time.

This substance, dissolved in dry ether was treated with a current of dry hydrogen chloride, when, a quantity of crystalline compound precipitated. Ether and excess of hydrogen chloride was then driven off at room temperatures, and the crystalline substance remaining behind was well washed with cold glacial acetic acid, drained until dry on the porous porcelain plate and then recrystallised from acetic ether. The pure hydrochloride showed a melting point 117°-118°, and proved to be identical with cadinene dihydrochloride as no lowering of melting point occurred on mixing it with cadinene dihydrochloride from other sources. Exactly the same thing had been experienced by Semmler and Jonas in handling the sesquiterpene alcohol from galbanum oil, and they had given the name "cadinol" to it. They had stated that it represented a tertiary sesquiterpene alcohol, and that it was liable to break into cadinene and water, but failed to prepare any definite crystalline derivatives therefrom.

With a view to obtain a crystalline phenyl urethane, the purified alcohol was let react with phenyl isocyanate. For this purpose, 2.2 gr. of the freshly distilled substance and 1.2 gr. of phenyl isocyanate was mixed in the warm and kept for 20 days in a desiccator, when the mixture congealed into a crystalline mass. Then, it was treated with petroleum ether and got rid of diphenyl urea in the usual manner, and at last, a crude phenyl urethane m.p. = 128°-130° was obtained, which after recrystallisations from alcohol showed a melting point 134°-135°.

The attempt to prepare the benzoate, the acid phthalate, the paranitrobenzoate, the hromide, or the xanthogenate, turned out altogether to be futile, and no crystalline compound was obtained. Only, it is worthy of note that the petroleum ether solution of the sesquiterpene alcohol, on treatment with an aqueous chromic acid solution assumed a characteristic red colouration, which according to Wienhaus showed the formation of chromic acid ester. Even

though it was impossible to get any crystalline chromic ester, this colouration and its poor affinity towards phthalic anhydride suggests that the authors' sesquiterpene alcohol also to be of a tertiary nature.

Ten grams of the rectified product from (9) was oxidised in aqueous acetone solution with 25 gr. of potassium permanganate at 50°-60°, the resulting mass was steam distilled to expel the unoxidised oil, and then, the aqueous residue, as well as the manganic mud, were separately extracted with ether, the ethereal solutions united and evaporated, when a small quantity of a yellowish oil together with a little crystalline residue remained behind. On standing for a length of time, the whole coalesced into a gruel-like mass, which was dried on the clay plate and the crystalline body recrystallised from benzol. The resulting crystal melted at 170°, but, on account of the small quantity available, nothing has been done to determine the nature of the substance.

Thirty grams of the substance was dissolved in an equal amount of pure formic acid, and warmed on the water bath for fifteen minutes, then the acid was neutralised with caustic soda, the hydrocarbon thus formed was extracted with ether, ether evaporated off, and the hydrocarbon boiled over metallic sodium at 165°-180° for 4 hours, and then rectified in vacuo.

This hydrocarbon gave a dihydrochloride m.p. 117°-118°, and a dihydrobromide m.p. 124°-125°, which turned out to be identical with those of cadinene. Also a nitrosate melting at 110°-111° was obtained in the usual manner. From these it is obvious that the product of dehydration is cadinene.

From the foreging experiments it seems possible that the authors' sesquiterpene alcohol might be identical with Semmler's cadinol, but considering the assumed constitutional formula for cadinene, there still remains much to be determined before the identity is claimed.

SUMMARY.

1. The wooden chips of *Taiwania Cryptomerioides*, Hayata, give on steam distillation 0.23 per cent. of an oil, consisting chiefly of sesquiterpene and sesquiterpene alcohol.

2. The sesquiterpenes in the oil are chiefly cadineue, with a little humulene and caryophyllene.

3. From the cadineue, a new oxidation product $C_{12}H_{22}O_2$ (m.p. = 142°-143°) was obtained.

4. The sesquiterpene alcohol in the oil, to which the authors suggest the name "taiwanol," closely resembles cadinol of Semmler and Jonas. From cadinol no crystalline phenyl urethane could be obtained, but in case of taiwanol, it affords a crystalline pheyl urethane melting at 134°-135°, and furthermore, it gives a neutral oxidation product (m.p. 170°) if oxidised with permanganate in acetone solution.

Department of industry,
Government Research Institute of Formosa,
Taihoku, Formosa.

ELECTROLYTIC PRODUCTION OF HYDROGEN AND HYDROXIDES.

By R. SAXON, B.Sc., F.C.S.
Mem. Soc. Chem Ind.,
Mem. Amer. Chem. Soc.

TUNGSTEN.

Using thick tungsten wire as anode, any other metal or conductor as cathode, water as the electrolyte, and a current of 240 volts from the lighting circuit, DC., hydrogen is evolved rapidly from the cathode, and a misty cloud of colloid fills the liquid. The liquid shows a faint yellow tinge and becomes suffused with the suspended tungstic acid, H_2WO_4. Obviously as with chromium the acid oxide is formed straight away, and unlike the case of iron the trioxide is the only oxide that perists. The acid may be obtained as a white-yellow powder by evaporation. It does appear that this group of elements containiug chromium, tungsten, etc., shows the decided tendency under electrolysis, oxidation to form the higher oxide immediately. The oxide of tungsten is insoluble almost in water, but the chromic oxide is not, yet under electrolysis chromic acid results.

POTASSIUM BICHROMATE.

A saturated solution of potassium bichromate gives off a brisk stream of oxygen bubbles from a platinum anode and hydrogen from the cathode, and as the action continues potassium bichromate is thrown out of solution. There is no evidence as with potassium salts of the formation of potassium hydroxide, or the metal. There is a strong smell of ozone. There is not at any time produced the insoluble hydroxide of chromium.

Chromium Sulphate.

The green chromium sulphate in saturated solute form, on electrolysis gives immediately oxygen at the anode and the insoluble chromic hydroxide at the cathode, the liquid becomes acid from the production of sulphuric acid, just as in the case of other sulphates (most abundantly, copper sulphate).

Thus we see that chromic acid or its salts does not give any reduction products as the chromic hydroxide, but seeks to maintain the acid character of the chromic anion. On the other hand if the metal be positive in the salt there results immediately the hydroxide, as with every other metal tried. Some metals whose hydroxide is difficult to get give it copiously in clouds on electrolysis. As we get further from the copper end of these "intrusive strata" metals so we get the tendency to deposit the metal less marked, and the tendency to maintain the higher oxide hydrate more and more marked.

SEPARATION OF NICKEL AND COBALT.

The following method is claimed to be capable of accurate determination of the trace of nickel present in "nickel-free" cobalt salts. The salt is dissolved in a minimum of water, and the solution is treated with a saturated potassium cyanide solution until the precipitate has re-dissolved. The cobalt cyanide is oxidised with 3 per cent. hydrogen peroxide; excess is destroyed by evaporation to one-quarter volume. A slight precipitate, insoluble in excess of cyanide, is filtered off. The filtrate is treated with solid dimethylglyoxime, and warmed; 40 per cent. formaldehyde is added until the solution smells of it; the nickel cyanide reacts with the solid reagent, the cobalticyanide remaining unaffected. After standing, the precipitate is collected, washed, dissolved in dilute hydrochloric acid, the solution is filtered, and the nickel is precipitated with 1 per cent. alcoholic dimethylglyoxime.

CANADIAN PLATINUM.

All the Canadian platinum and allied metals are obtained from the treatment of the Sudbury nickel-copped matte, with the exception of a few ounces of platinum obtained from the black sands of British Columbia, and a small quautity produced as an impure residue in the refining of gold at Trail, British Columbia.

MODERN TOWNS' WATER PURIFICATION.

The Kempton Park Plant (London).

By A Well-Known Engineer.

At a recent general meeting of the Institution of Water Engineers, held at the headquarters of the Institution of Civil Engineers, the proceedings included the reading of a highly interesting paper "The Kempton Park Primary Filters of the Metropolitan Water Board," by S. Walker, Deputy Chief Engineer of the Board. This gives for the first time a detailed official description of the very large rapid gravity sand filtration plant of 48,000,000 gallons per 24 hours capacity, opened on the 24 October, 1929, the largest in Great Britain. Essentially the equipment consists of 24 "Paterson" filters each of 2,000,000 gallons per 24 hour capacity, constructed of reinforced concrete, 26ft. long by 19ft. wide by 12ft. deep. The filtering area of each bed is 26ft. by 16ft., or 416 square feet, the medium being a 27ins. bed of Leighton Buzzard sand supported on a graded layer of pebbles, with a filtering speed of 100-200 gallons per sq. ft. per hour. Normally 22 filters are operated, with 2 as a stand-by for cleaning purposes, corresponding to a duty of 44,000,000 gallons per 24 hours. Also the whole plant is arranged in four batteries of six units each, equipped with automatic inlet control by means of a 36ins. double beat equilibrium valve, the movement of which is determined by a 4ft. diameter disc type float, thus keeping the water at one standard level irrespective of the rate of flow. In addition, there is provided beneath the primary filters four sedimentation tanks for treating the wash water on the most efficient principles, this being returned to the plant, one for each group of six filters.

The new installation, as indicated, is being operated as a "primary unit," and works in series with the old stationary sand filters which now function as "secondary" units, and are thereby able to operate at about four times the normal speed, since the water is already almost entirely clear from the primary filters. The general details of the standard rapid gravity filters of the Paterson Engineering Co., Ltd., of London, operating in most countries of the world are now generally well known, the sand being agitated with compressed air for cleaning so that the separated impurities are disentangled and swept away by a momentary reversal of the water flow

for which convenient valves and pipe circuits are provided, the whole operation only taking a few minutes, the same sand lasting for years. The Metropolitan Water Board installed their first rapid gravity sand filtration plant in 1921 at Barn Elms Works and followed this with an important installation at Walton in 1926 and generally they are of the opinion the ideal practice is to use existing slow sand filters with hand or machine cleaning of the sand as secondary filters to finish off the process with modern rapid gravity filters as the primary equipment. Also when necessary the "Chloronome" is used, as at Walton, for continuous sterilisation by means of a measured trace of chlorine gas, generally about 1 part per 2,000,000 parts of water and a large proportion of London's water supply, which averages about 280,000,000 gallons per day for over 7,000,000 people, is now operated on these lines.

CORROSION OF TIN PLATE CONTAINERS BY FOOD PRODUCTS.

A small laboratory for research on canning was established at the Low Temperature Research Station, Cambridge, in 1927. Accounts of its work have appeared in the Annual Reports of the Food Investigation Board. It is appropriate that the first Report to appear in the series of Food Investigation Special Reports should deal with what is generally recognised to be the most fundamental problem with which the canning industry is confronted, namely, the corrosion of the tin-plate container.

It is commonly believed that corrosion is less serious in the canning industry in Great Britain than in America. If this is indeed the case, it is to be attributed to the lower temperatures prevailing in Great Britain and to the smaller variety of fruit packed here; and it must not be forgotten that the protection afforded by low temperatures will not obtain in many parts of the British Empire or in the case of exported British canned goods.

The Report embodies the results of three years' work; it is hoped that it will be not only of assistance to the canning industry, but also of interest to those who are concerned with the wider problem of corrosion in general, which is of such growing importance in industry to-day.

NEW GREEN DYESTUFF DISCOVERY.

A Green Shade in the "Ice Colours."

A fresh triumph of British chemical research is provided by the discovery in the laboratories of the British Dyestuffs Corporation of a new green synthetic dye of a bright green colour known as DURATOL GREEN G. Behind this discovery lies the story of more than half a century of patient endeavour and reasearch.

Over 50 years ago, in 1880, a North Country dyestuff firm discovered a new method of dyeing known as dyeing with "ice colours" because they could only be used in water kept cold with ice. With these dyes rich and brilliant shades of red were obtained rivalling in beauty and to a certain extent replacing the famous Turkey Red. To dye with Turkey Red takes many weeks as against less than an hour with "ice colours."

Just before the War German chemists discovered a new series of these dyes and consequently Germany became pre-eminent in this field. Hundreds of "ice colours" became available so that not only red shades could be dyed but yellows and oranges, blues and violets, blacks and browns. Yet no green was forthcoming and it is a curious fact that the dyestuffs chemist engaged in building up complicated molecules to make new dyes of increasing fastness has always found that green presents one of his most elusive problems. Nature, so prodigal of green, guards her secrets jealously, and the green shades discovered in the laboratory have so far been few and far between. Duratol is in fact only the second successful green discovered in recent years, the other being the well-known Caledon Jade Green.

Duratol is a new green in the "ice" range and its discovery is the result of a brilliant piece of systematic team work. It is a bright grass green of outstanding fastness in washing and boiling. It will actually stand boiling for six hours in an alkaline solution without changing shade, so that it is safe to say it will survive all the laundering it is likely to meet with in such articles as dress goods, bedspreads and the new fashionable coloured tablecloths. It can not only be used for colouring cotton and linen articles, but also artificial silk, as in deep shades a rich bottle green of great value to the trade can be obtained.

This unique dyestuff is further evidence that the British dyestuff industry is fully

alive to the importance of being first in the field in the supply of the novelties which are essential to the prosperity of the textile trades.

THE SALT INDUSTRY OF CANADA.

The salt industry of Canada is one of the oldest, non-metallic industries of the country, dating back to the early years of the last century when the Hudson's Bay Company obtained their local supplies from the brine springs of the Mackenzie basin.

The discovery of salt in Ontario in 1886, was, however, the real beginning of the industry on a substantial basis, and production from the Ontario field has been continuous since that time. The opening of the Malagash deposits in Nova Scotia in 1918 inaugurated the first rock salt mine in the country, and has materially assisted in supplying the demands for salt in the Maritimes.

With the discovery of rock salt at Mc Murray, Alberta, and the more recent encountering of thick beds of salt in drill holes just south of Moncton, New Brunswick, the known resources of Canada in this mineral have been considerably extended.

Sodium chloride or common salt as it is more familiarly called, finds a use in a large number of industries, and the consumption for domestic use forms a steady demand, depending upon the population. The increasing use of salt in Canada for the manufacture of chemicals has in recent years caused a rapid rise in the prodnction of salt, and there is every reason to look forward to a rapid expansion of the industry as the country grows.

To meet the demand for information relating to the Canadian salt industry, the Mines Branch of the Department of Mines, has recently published a report by L. H. Cole, entitled: "The Salt Industry of Canada," this report supplemeuting and bringing up to date the previous report on the same subject issued by the Mines Braneh over fourteen years ago.

The present report consists of 116 pages, and is profusely illustrated with photographs, diagrams, and maps. It covers the salt occurrences throughout Canada, takes up the minerology, and technology of salt manufacture, and briefly describes the allied industries suing salt in their process. A chapter is also devoted to the consumption and marketing of salt and includes general salt statistics.

JUBILEE CELEBRATIONS OF THE SOCIETY OF CHEMICAL INDUSTRY.

Leading scientists from all over the world are to attend the Jubilee Celebrations of the Society of Chemical Industry, which will take place in London during the week commencing July 13, under the patronage of His Majesty the King. The proceedings will be under the Presidency of Sir Harry McGowan, President of the Society, and will comprise a wide programme of scientific discussions, social functions, and visits to industrial centres. Several hundreds of the Society of Chemical Industry's 7,000 members are to attend from Overseas, and the Celebrations will open with a Reception by the Lord Mayor of London at the Gnildhall.

The Annual General Meeting of the Society will be held in the Duke's Hall, Marylebone, on Tuesday, July 14, when Sir Harry McGowan will deliver his Presidential Address. In the afternoon a garden party arranged by the Shell Royal Dutch Oil Group will take place at Teddington. Wednesday will see the presentation of the Society's Medal to Dr. Herbert Levinstein, and the Annual Dinner at the Great Central Hotel. On Thursday evening a Reception is to be given by the President at the Savoy Hotel.

During the Celebrations Honorary Membership of the Society—a very rare distinction, only previously awarded on six occasions during the 50 years of the Society's existence—is to be conferred on representative leading members of the chemical industry in each of the world's principal industrial countries, and a feature of the proceedings will be the delivery of addresses by these distinguished scientists on various days during the Celebration Week. In addition there will be meetings for the reading and discussion of papers, lectures and addresses, and au interesting meeting at the Great Central Hotel when papers presented by the Canadian Sections of the Society will be read.

A very wide selection of works and factory visits will be available for Members of the Society. Amongst the well-known firms whose works will be visited may be mentioned Achille Serre, Ltd.; British Drug Houses; the General Electric Co.; South Metropolitan Gas Co.; Burroughs Wellcome & Co.; Huntley and Palmer, Ltd.; and J. Lyons and Co., Ltd. The Anglo-Persian Oil Co., Research Station at Sudbury, and the National Physical Laboratory

and Chemical Research Laboratory at Teddington will also be inspected by large parties.

Throughout the week of the Celebrations a comprehensive Exhibition of British Chemical Plant and Research and Recording Instruments, arranged by the British Chemical Plant Manufacturers' Association, in co-operation with the Chemical Engineering Group of the Society of Chemical Industry, will be held at the Central Hall, Westminster. The Exhibition, which will be opened by Sir Harry McGowan on Monday morning, will cover the whole range of the industry, and practically every important firm of British Chemical Plant Manufactnrers will be exhibiting. A Section of the exhibition will be devoted to the work of the Department of Scientific and Industrial Research, and of the various Research Associations dealing with the following industries: Boots, Shoes, and Allied Trades; Cast Iron; Leather; Linen, Non-Ferrous Metals; Paint, Colour and Varnish; Rubber; Wool.

ROUMANIA.

The Commercial Secretary to His Majesty's Legation at Bucharest, reports that he has received from the Central Licitations Office, which is the central office for controlling, co-ordinating and issuing calls for tenders from all Roumanian Government Departments, a request for the names of British firms interested in tendering for the various supplies required by Roumanian Public Departments.

Apparently the Central Licitations Office (O.C.L.) has under contemplation the compilation of lists of Contractors in Roumania and other countries, which it is intended shall be recommended to all Roumainian Government Offices allowed under the Public Accountancy Law to hold restricted licitations.

No indication has been given regarding the range of commodities which Roumainian Public Departments are accustomed to purchase, but those British firms interested in the matter who wish to have their names included in the list referred to should communicate, preferably through local agents, with

Central Licitations Office (O.C.L.),
Ministerul De Finante,
Cal Victoriei III,
Bucharest, Roumania.

GENERAL NOTES

TRADE SITUATION AT HONG-KONG AND CHINA.

The commercial situation at Hong-Kong is at present completely dominated by the heavy depreciation in the value of silver, which is having a most serious effect on the import trade. The most striking examples are perhaps to be found in the case of the companies distributing Oil and Chemicals for these corporations selling articles in universal use, having their own efficient distributing systems and being in a position to adjust their prices to meet market conditions are in a better position than other importers to cope with difficult situations, but even they are now finding that the enormous increase in local selling prices necessitated by the unfavourable exchange is effecting their business very materially.

Sales of kerosene in South China have diminished by at least 30 per cent., and this is hardly to be wondered at in view of the fact that the price is now nearly double that ruling twelve months ago and that a large proportion of the ultimate consumers is to be found amongst the poorest classes of the population, who have been compelled to restrict their purchases or to revert to more primitive illuminants of native origin. The rapid growth in the demand for gasolene owing to the development of motor traffic in the Southern provinces has also been checked, partly owing to political troubles which have interfered with the progress of road construction but also as a result of the great increase in cost. In this case, however, the higher price of motor spirit has probably been a less serious factor than the effect of a low exchange, accompanied by higher Custom duties, on the importation of motor cars.

The effect of the fall in silver on the trade in heavy chemicals, and especially in Sulphate of Ammonia which is largely used in South China as a fertiliser, has only recently begun to make itself felt, but the price has now been driven up to a point at which the poverty-stricken farmer finds it difficult to satisfy his requirements and the demand is falling off. In connection with the Chemical trade it may be of interest to mention that the Soviet has recently made its first appearance in the South China market, a small consignment of Caustic Soda of Russian origin having been sold through a German firm in Hong-Kong

at about 20 per cent. below ruling prices.

Textiles.—The returns of imports of cotton piece goods into Hong Kong recently published make depressing reading, showing as they do that Great Britain's share in the South China market is rapidly shrinking to vanishing point. Whilst in 1924 Great Britain's proportion of the total imports amounted to 55.59 per cent. it had fallen in 1930 to 13.41 per cent., whilst Japan's had in the meantime risen from 33.05 per cent. to 66.47 per cent.

Both as regards cotton and woollen textiles it may be stated that in one respect the present situation at Hong Kong is distinctly satisfactory. Contrary to the practice in Shanghai sales in Hong Kong are usually effected in local currency, not in sterling, with the result that dealers who bought goods six months ago at exchange rates at least 30 per cent. higher than those ruling to-day, have had every reason to be satisfied with their bargains and have in fact made large profits. Clearances have been brisk, much old stock has been disposed of, and the statistical position in Hong Kong is more satisfactory than for many years past. An unusual feature of the situation has been that in many cases dealers have found it more profitable, instead of disposing of their purchases in the China market, to ship them to Singapore, Bangkok and other ports, where better prices are obtainable. For the time being little or no new business is being effected, as dealers are holding off in the hope of a rise in exchange, but at least as regards woollens there is reason to believe that with any substantial advance in the value of silver or even some evidence of stability purchases for next season's requirements would be on a considerable scale.

Machinery.—There would appear to be little doubt that it is as a potential market for machinery and engineering supplies that South China offers the most favourable prospects for British manufacturers, and both in Hong Kong many enquiries are being received for electrical and other plant. Amongst projects mentioned are the establishment of factories for the manufacture of artificial silk yarn and cotton thread, and as regards the former it is undeniable that the very high duty imposed on this article under the new Chinese tariff is a strong incentive to attempts being made to produce it locally. Apart from private enterprises, moreover, municipal improvements, railway and road construction, conservancy works, water supply and electric power schemes are all under consideration, and the resumption of work on the Southern section of the Hankow-Canton Railway has led to a revival of interest in the development of valuable mining areas which have hitherto been lacking in transport facilities.

The most ambitious scheme at present being considered is for the installation of a hydro-electric power station at Yingtak, about 100 miles from Canton, which is estimated to cost about 10,000,000 dollars, but no negotiations for carrying the scheme into effect have it appears yet been started.

GERMAN BUNSEN SOCIETY.

"The condition and prospects of the electro-chemical industry" is the title chosen by J. Billiter, the well-known authority on applied electrochemistry and inventor of the Billiter cell for his address at the 36th General Meeting of the German Bunsen Society for applied physical chemistry, the leading association of scientists, research workers and technologists in the field of applied physical chemistry. The meeting is to take place from the 25 to 28 May, 1931. The recent advances of this important branch of the chemical industry, which will be specially dealt with, should be of interest to very great numbers. Other papers will be read by W. Schmidt, Bitterfeld, on "The Technology and Applications of Electron Metal." ("Technologie und Anwendung des Elektronmetalles.") and H. Röhrig, Lactawerk, on "Electrically Prepared Oxide Films in Aluminium." ("Elektrotisch erzeugte oxydische Überzüge auf Aluminium.") Detailed information about the programme of this important symposium will be published shortly.

VISITORS TO THE DOMINIONS AND COLONIES.

The attention of British firms who may be making arrangements for their representatives to visit Empire markets is directed to the facilities and assistance which the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, is in a position to render.

The Department will furnish such representatives with letters of introduction to H.M. Trade Commissioners in the Dominions and Colonies. These officers are always pleaced to welcome visitors from the United Kingdom and, through their organisation, are well placed to render considerable assistance to representatives of British firms.

Proceedings and Notices of Societies

GEOLOGICAL SOCIETY.

April 22.

1. *Xenoliths of Igneous Origin in the Trégastel-Ploumanac'h Granite, Côtes-du-Nord, France.* By HERBERT HENRY THOMAS, M.A., Sc.D., F.R.S., V.P.G.S., and WALTER CAMPBELL SMITH, M.C., T.D., M.A., Sec.G.S.

In the neighbourhood of Trégastel, a red porphyritic biotite granite crops out along the coast and forms the rising ground for several miles inland. In parts, this granite is remarkable for the abundance of xenoliths which it contains. Some of these are of sedimentary origin, but the majority are of the kind usually referred to as "basic segregations." A patch of basic rock covering an area of about a mile and a half from north to south and about half a mile wide is entirely surrounded by granite. Its most basic portions are of biotite-bearing olivine-norite. Impregnation by, and reaction with, the invading granite has given rise to a whole series of hybrid rocks varying through hypersthene-gabbro, augitic quartz-biotite-diorite, to quart-biotite-diorite, and even to a biotite-rich granitic stage. Near the junction of the granite with the hybrid rocks, "basic segregations" are very numerous. When examined they prove to have a structure and mineral composition corresponding to the various stages presented by the basic hybrids, and on the extreme margin of the hybrid rock the xenoliths may be seen in the process of separation from the parent mass. The occasional presence of large felspars in the xenoliths is discussed, and the Authors are of opinion that these are xenocrysts and have not grown in place. Evidence is produced to show that the basic mass from which the xenoliths were derived was most probably part of the roof of the granite.

2. *The Loch Doon "Granite" Area, Galloway.* By CHARLES IRVING GARDINER, M.A., F.G.S., and Prof. SIDNEY HUGH REYNOLDS, M.A., Sc.D., F.G.S.

The Loch Doon "granite" mass has a length of 11½ and a maximum width of 6½ miles and covers an area of about 47 square miles. The plutonic rocks are almost everywhere surrounded by high hills composed of metamorphosed Ordovician sediments.

The plutonic rocks are of three main types:—

1. The prevalent rock is a quartz mica diorite or tonalite, specific gravity 2.71.
2. The central ridge is of biotite granite, specific gravity 2.68.
3. At the southern and north-western ends is a norite, specific gravity 2.81.

Analyses were prepared by Mr. E. G. Radley of each of these rock-types. The most interesting problem concerning the plutonic mass is to determine the mutual relations of the rocks and to ascertain whether their different varieties may be considered to have arisen by differentiation subject to intrusion, or whether the facts point to each of the three rock-types being a separate intrusion.

SOCIETY OF GLASS TECHNOLOGY.

Some Notes on the Manufacture and Performance of Slip Cast Tank Blocks. By P. HALLER, M.Sc.

Mr. Haller described worked which had been undertaken to improve, if possible, the performance of blocks used in tank furnaces producing colourless glass at rapid melting rates for automatic bottle making machines. Experience with blocks of various types, exposed to varied conditions, led to the conclusion that the erosive effect due to the rapid flow of the glass was the chief destructive agent to be overcome. The work described offered a direct comparison, based upon works trials, of slip-cast, and plastic-shaped blocks. The blocks experimented upon had percentage chemical compositions of 63-65 SiO_2; 30-32 Al_2O_3; 3 Fe_2O_3; with less than 1 of alkalies. The ultimate squatting point was cone 32 (1710° approximately). With this composition, which, however, could be varied at will by choice of raw materials, it was difficult to get a block of 18 per cent. porosity. Parallel with development in casting, efforts were made to improve blocks from the same clay made by plastic shaping. Decided improvements resulted in general refractories, resistance to solvent attack, but practically no improvement in resistance to erosion. Hard fired blocks with a porosity down to 19½ per cent., tended to crack under thermal stress, and hard firing alone, did not smooth out previous defects. Turning to the slip-cast blocks, the basis of the method was described and particulars of procedures given. Sodium silicate and sodium carbonate were

used as deflocculants, the ratio of the two being adjusted by the method of trial and error to suit each slip. Clays varied considerably in the ease with which they were broken up in the plunger, and deflocculated, and unless a clay slaked well responded to the deflocculants, and gave a slip which, after dilution and settling passed the 200 mesh I.M.M. sieve, it was rejected for casting purposes. In plastic work, about 60 per cent. of grog was the maximum proportion used, whereas in slips 60 per cent. by weight was about the minimum. Cast blocks had slightly less porsity than the corresponding hand make blocks, but the difference was small. Sillimanite blocks were fired to 20-27 per cent. porosity. The cast blocks possessed great mechanical strength, but the outstanding difference between comparable cast, and hand-made blocks lay in the texture, the greater regularity and homogeneity of texture of the cast block being patent on the most cursory examination. Several works trials of the cast blocks had been made in one case comparable hand made blocks had been placed on one side of a small oil fired tank furnace melting colourless glass, while the cast blocks were placed in the corresponding position on the other side. The hand made blocks were worn to destruction in normal time, although they had a porosity below 20 per cent., while the cast blocks showed much less wear, and were apparently good for many more weeks. A projective layer had formed on the cast block surfaces, this formation seeming to depend, not only on the nature of the block, but upon some form of interaction with the glass in working. The behaviour of such cast blocks could not be prejudged by a specification resting on any other basis than a test simulating closely actual conditions of use and in particular the have little bearing on the blocks described.

Studies of Clay Mixtures for Glass Melting Pots. Part I and Part II. By J. H. PARTRIDGE, Ph.D., and G. F. ADAMS.

(Comunication from the Staff of the Research Laboratories of the General Electric Company, Limited, Wembley.)

Four major causes of pot failure were stated :—

(*a*) cracking due to thermal shock.

(*b*) cracking due to shrinakge.

(*c*) ripping, bursting, splitting and squatting.

(*d*) corrosion or causes attendant thereon.

The authors dealt with cause (*a*) and (*b*) in Parts I and II of the paper. Two types of pot, one covered, and holding 35 cwts. of glass, and the other open with a capacity of about 10 cwts. of glass were chosen as examples for the application of the experimental data. The thermal conditions to which the large pot was subjected during founding were determined experimentally and it was found that there was considerable thermal shock to the inside layers when charging the batch, the inner surfaces were cooled more than the outer, a considerable portion of the bottom was much cooler than the rest of the pot, the exterior zone of the pot bottom was sometimes cooler, and sometimes hotter than the interior zone, and this reversal of temperature gradient took place once during every found.

Part I. Resistance of Clay Mixtures to Thermal Stock.

Tests were carried out on standard mixtures and modifications thereof, one standard containing 26-27 per cent. Al_2O_3, the other containing some 30 per cent. Al_2O_3. The grogs were of the same composition as clays, and modifications were made by varying the amount of grog, and also by substituting finely ground alumina in lieu of an equal proportion of grog. Particulars of the compositions of the mixtures, and of the grading of the grog were given. The results showed that the standard aluminous mixtures did not resist thermal shock to any marked degree. When the grog contained too much fine material, the resistance was decreased. Experiments made with a siliceous clay, containing 20 per cent. Al_2O_3 and various proportions of grog, showed that there was an optimum amount of grog of any particular grading which could be used with a clay. Again, fine grog resulted in less resistance to cracking than did the coarser particles. The the aluminous ones fired to the temperature stated in their ability to withstand sudden changes of temperature.

The Shrinkage of Clay Mixtures During Life.

Samples of the clay mixtures were heated in the furnace to 1320° C., maintained at this temperature for a given time, cooled, and the change in volume measured by means of a mercury displacement volumeter. The heating, and cooling and measuring were repeated over a consider-

able period of time. From the results obtained it was obvious that the aluminous mixtures decreased in volume over a considerable period, whereas the siliceous mixtures remained almost constant in volume. The coefficient of thermal expansion of the siliceous mixture was much less than that of the aluminous mixture. From observations made upon small pots in use, the service from 19 siliceous pots was nearly one quarter that obtained from 156 aluminous pots. It was expected to improve the service of the siliceous pots by reducing the grog from 50 per cent. to 40 pe rcent., thereby reducing the tendency for slight cracks to develop in drying. The records of service obtained from pots over a considerable period were in agreement with the results of the laboratory technique described.

CHEMICAL SOCIETY OF JAPAN.

The following papers were read :—

Thioxy-stannites of Calcium, Strontium and Barium. By SETSURO TAMARU and YASUO TANAKA.

Terpenes and Related Compounds. VIII. n-Proplyloxy-isoeugenol and-isochavibetol. I. By NENOKICHI HIRO.

Terpenes and Related Compounds. IX. 4-Oxy-3-ethoxy-1-propenylbenzene and 3-Oxy-4-ethoxy-1-propenylbenzene. I Synthesis. By NENOKICHI HIRAO.

Electrolytic Oxidation of Glutamic Acid. (The Electrolytic Reactions of the Amino Acids and Related Compounds. I). By YOSHITARO TAKAYAMA.

Sinomenine and Disinomenine. XXII. Sulfonation of Alkaloids. By KAKUJI GOTO AND ZENJIRO KITASATO.

The Determination of Gold, Silver, and Copper. (Studies on Gravimetric Analysis by Means of the Thermobalance. VIII.) By KICHIJIRO ISHII.

Constituents of Coriaria japonica, A. Gray. III. Catalytic Reduction of Tutin. By KONO KINOSHITA.

February 14, 1931.

Studies on Sinomenine. By KAKUJI GOTO.
Volumetric Analysis of Alkali Metals. By SAICHIRO NAGAMI AND MAKOTO TASHIRO.

On Fuel Cell. By SETSURO TAMARU AND KAZUO OCHIAI.

NOTICES OF BOOKS.

Problems in Practical Physical Chemistry. By F. A. PHILBRICK, B.A. Pp. xiv+146. London : J. M. Dent and Sons, Bedford Street, W.C. 1931. *Price 3s. 6d.*

How many physical chemists are familiar with the reactions between cupric oxide and sulphur dioxide, mercuric chloride and hydrogen peroxide, potassium permanganate and nitric oxide? Again, what are the decomposition products of manganous oxalate, or barium iodate? These are a few of the thirty odd problems given in Mr. Philbrick's stimulating book which formed a valuable introductory volume for practical physical chemistry. The problems, which may be looked upon as miniature researches (the student could be encouraged to try variations of procedure or even suggest his own methods in addition to those given in the text), include the investigation of reactions, ionic equilibria, the phase rule, reaction velocity, electrical conductivity and a study of indicators.

None of the experiment should be beyond the powers of students reading for intermediate chemistry examinations. The details given are adequate and the experiments could frequently follow lectures upon, say, *Reaction Velocity or Conductivity of Solutions.*

The book should be welcomed by both students and teachers of physical chemistry.

Chemical Change. By D. B. BRIGGS, M.A., F.I.C. Pp. vi+166. London : J. M. Dent and Son. 1931. *Price 5s.*

The distinctive feature of a chemical change is that some alteration in chemical constitution has taken place, new kinds of matter may also appear. The object of Mr. Brigg's volume is to provide an introduction to the more advanced works on fundamental chemistry for those who have already become acquainted with the elements of the science. Some of the various aspects of chemical change are here developed in a historical presentation of the subject.

The Author discusses the types of chemical change, the kinetic-molecular theory, the law of mass action, the influence of (*a*) temperature (*b*) pressure (*c*) medium and (*d*) substituents upon chemical change, catalysis, technical applications of photochemistry have also not escaped the attention of the author who has thus made a very comprehensive survey of a fundamental aspect of chemical science.

Organic Syntheses. Vol. XI. Edited by PROF. CARL S. MARVEL. Pp. viii+106. London: Chapman and Hall, Henrietta Street, W.C. 1931. Price 8s. 6d.

Organic Synthesis has now established itself as an annual publication of satisfctory methods for the preparation of organic compounds and reagents which have been worked out by one or more investigators and which have then been checked by independent workers. In this way convenient processes for preparing some 300 substances have been worked out, and are available for organic chemists who require them as reagents or for research purposes. Among the 31 preparations given in vol. XI are those for—aerolein acetal, 1-Amino-2-Naphthol hydrochloride, azoxybenzene, cyanogen bromide, ethyl pimelate, *p*-iodoaniline, *n*-pentane, thiobenzophenone and triethyl carbinol. The preparations are described in detail and notes are appended in each case giving explanations for the various steps which might not be obvious from a casual reading.

The aim has been to place on record convenient methods for preparing substances which have hitherto not been readily obtained in reasonably good yields.

The Vitamins. By PROF. H. C. SHERMAN and S. L. SMITH. Second edition. Pp. 575. New York: Chemical Catalogue Co. 1931. Price 6 dollars.

It is gratifying to find that several of the important monographs issued by the American Chemical Society and published by the New York Chemical Catalogue Company, are now going through a second edition. Prof. Sherman's *Vitamins* appeared nearly a decade ago. Since then few branches of chemical science have made such rapid strides and the volume now runs to nearly 600 pages of which over a third is occupied by the most valuable and comprehensive Bibliograpby (to 1930).

In the seven succeeding chapters the authors have compressed and arranged the essential knowledge concerning vitamins B (B_1), G (B_2), C, A, D and E.

Their properties, nature and functions are all given together with the consequences of their absence from any diets.

The importance of their study cannot be over-estimated and therefore the appearance of a revised edition of this monograph is particularly welcome.

It is pointed out in the opening chapter chapter that when it came to be recognised that there were "accessory food factors" essential to any dietary if health and growth were to be maintained these were termed vitamines. To distinguish their special function and to identify them they were given such terminology as "growth-promoting, fat soluble vitamine A" "water soluble antiscorbutic vitamine C," etc. They are not necessarily amines so that the final *e* has been dropped. It has also been found that they are of very different chemical nature from each other. The original complex vitamin B has been split into B_1 and B_2 (or G) and its is quite likely that the final number has not yet been reached.

New Discoveries relating to the Antiquity of Man. By Sir ARTHUR KEITH, M.D., D.Sc., F.R.C.S., F.R.S. Pp. 512 with 187 Illustrations. London: Williams and Norgate. 1931. Price 21s.

Sir Arthur Keith's *Antiquity of Man* first appeared in 1915. In 1929 it was reissued in two volumes, so great had been the accession of fresh knowledge. A third revised edition appeared in 1929 and is followed by the present work which incorporates a mass of new knowledge, throwing further light upon the subject. In this book Sir Arthur considers the question of man's origin in the light of discoveries recently made in all parts of the world. Following his well-known methods, the author conveys the reader to the site of the discovery, explains how the fossil remains are found, how their antiquity is decided and their scientific significance. Recent discoveries in South Africa, notably the Taungs skull, are first considered, then the author turns to ancient Egypt and Palestine. Important fresh material has been supplied by excavations in Mesopotamia, China and particularly Moravia (Czechoslovakia).

During digging operations at Predmost and Vestonice in Moravia buried remains of mammoths and mammoth hunters have been discovered. In fact a paleolithic city dating back perhaps 20,000 years has been unearthed. Ornaments, idols, fetiches, pigments, toilet outfits, needle-cases and all kinds of implements were found in abundance. Though the mammoth hunters knew nothing of pottery they modelled clay.

Sir Arthur Keith next describes the "finds" in Java and Australia and he devotes some space to the early inhabitants of the British Isles. An attempt is made to correlate all this diverse information and to trace back the antiquity of mankind. A special section has been devoted to the evolution of the brain. The whole is written in non-technical language, yet with strictly scientific accuracy, and is so well illustrated that his evidence and meaning will be apparent to both non-specialist and specialist readers.

Economic and Trade Conditions in Australia (Report by R. W. Dalton, C.M.G. H.M. *Senior Trade Commissioner in the* Commonwealth of Australia). Pp. 237. H.M. Stationery Office. 1931. Price 3s. 6d.

For a number of months past the developments in the economic conditions in Australia have excited considerable interest. Much attention has been directed to the difficulties which have arisen in the affairs of the Commonwealth and to the underlying causes. During the current developments have been rapid, but the report by H.M. Senior Trade Commissioner in Australia relates primarily to the year 1930. Although it includes, as an appendix, a chronological statement of the main events of financial interest during that year, and these events are to a certain extent discussed in the report, the main value will be found in the attempt made to collate the varying complicated factors which have influenced the financial affairs of the Commonwealth in order to form a complete appreciation of the conditions as existing towards the end of the year. This survey thus supplies a basis on which a correct estimate can be formed of subsequent developments.

Thus in the opening chapters on General Conditions H.M. Commissioner deals fully with the unprecendented difficulties with which Australia, whose post-war prosperity has been so largely dependent on high world prices and overseas money markets, has had to contend. These difficulties were mainly financial in character and were accentuated by heavy borrowing over a long period of years. Imports had been maintained, by borrowing, at a much higher level than was justified by earnings, and even in "good" years exports had failed to cover external obligations.

Commitments in London amounted to about £38,000,000. The Commonwealth Bank had severely depleted its gold reserve in an endeavour to meet the external situation, over £34,000,000 worth of gold having been shipped during the 15 months ended September 1930. The result of these conditions has naturally been found in seriously reduced business opportunities, though for a considerable period local interests failed to recognise the position as other than a purely temporary depression.

In spite of the new tariff measures, exports of merchandise still failed to balance imports, although this position has subsequently been achieved. Little had been done by the end of the year to reduce wage rates although cost of living had been falling continuously. Increased income from the sale of Australian products abroad is what is most needed to retrieve the present position. Meanwhile British manufacturers must accept the fact that what was their second largest export market will offer a very much reduced demand for a number of years. An estimate is made of the probable normal future requirements. In His Majesty's Senior Trade Commissioner's view however, demand will return, and when it does it is to be hoped that British firms will again participate in its supply.

Production occupies the largest section of the report and primary production the major part of that section. The importance of an extensive treatment of these fundamental bases of Australian conditions is obvious. It is shown that the troubles which have fallen on the primary industries are almost wholly due to high costs of production and reduced selling prices. All relevant factors are reviewed, and the report quotes the views expressed by the principal primary producers' associations to the effect that, the tariff being fixed in the interests of the manufacturers, its incidence was unduly severe on the primary industries. During the whole of the post-war period production costs mounted, industry after industry complaining that it was impossible to produce with a profit. The burden of these demands was chiefly borne by the major industries, wool and wheat. So long as prices for these two products remained high, conditions were not too unfavourable but during the year it became evident that both industries must be affected in their turn.

The report has been issued for the Department of Overseas Trade and is obtainable from H.M. Stationery Office or through any bookseller.

Forthcoming Events.

MAY 1.

ROYAL INSTITUTION, 21, Albemarle Street, W.1., at 9 p.m. "Charlotte Bronte in Brussels." By Professor D'Arcey W. Thompson, C.B., D.Litt., F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS. *Meter and Instrument Section.* Savoy Place, Victoria Embankment, W.C.2., at 6 p.m. "High Voltage Precision Measurements." By Professor W. M. Thornton.

PHYSICAL SOCIETY. Imperial College of Science, S.W.7., at 5 p.m.

INSTITUTION OF MECHANICAL ENGINEERS. Informal Meeting, Storey's Gate, S.W.1., at 7 p.m.

MAY 4.

S.C.I. *London Section.* Annual General Meeting, Burlington House, Piccadilly, W.1., at 8 p.m. "Chemical Constitution of Coal." By Prof. W. A. Bone, F.R.S.

UNIVERSITY OF LONDON, Kings College, Strand, W.C.2., at 5.30 p.m. Course of three public lectures on "Biophysical Chemistry of Colloids and Protoplasm." By Dr. V. Cofman. Also on May 11 and 18.

MAY 5.

INSTITUTION OF CIVIL ENGINEERS, Great George Street, Westminster, S.W., at 6 p.m. James Forrdest Lecture. By Sir Thomas Stanton.

MAY 6.

INSTITUTE OF METALS. General Meeting.

INSTITUTION OF MECHANICAL ENGINEERS. Storeys Gate, S.W.1., at 8 p.m. Twenty-first Annual May Lecture on "Progress of Power Production." By W. B. Woodhouse.

ROYAL SOCIETY OF ARTS, at 8 p.m. Ordinary Meeting. "Preservation of the Countryside." By Major General Sir Fabian A. G. Ware.

SOCIETY OF PUBLIC ANALYSTS, Burlington House, Piccadilly, W.1., at 8 p.m. Demonstration of a New Development in Filter Paper." By E. J .Guild. "Rope Spore Content of Flour and its Significance." By A. J. Amos and D. W. Kent-Jones. "Separation of Tin from Tantalum and Niobium." By W. R. Schoeller and H. W. Webb. "New Method for Decomposition Products in Anæsthetic Chloroform." By N. L. Allport. "Contaminations in Morphine Deposited in the British Pharmacopœia Process for the Analysis of Opium." By J. N. Rakshit. Informal Dinner, 178, Piccadilly, at 6.30 p.m.

MAY 7 AND 8.

IRON AND STEEL INSTITUTE. Annual Meeting, Institution of Civil Engineers, Great George Street, Westminster, S.W., at 10 a.m. Presentation of Bessemer Gold Medal to Sir Harold Carpenter, F.R.S. Presidential Address. Papers for discussion :—"Production Economy in Iron and Steel Works." By O. Cromberg. "The Melting Shop of the Appleby Iron Co., Ltd." By A. Robinson. 2.30 p.m. "First Report on the Corrosion of Iron and Steel," being a report by a Joint Committee of the Iron and Steel Institute and the National Federation of Iron and Steel Manufacturers to the Iron and Steel Industrial Research Council. "Constitution of Scale." By L. B. Pfeil. 7.30 p.m. Annual Dinner, Grand Hall, Connaught Rooms, W.C. Tickets, 15s. MAY 8. — 10 a.m. "Accelerated Cracking of Mild Steel (Boiler Plate) under Repeated Bending," by W. Rosenhain, F.R.S., and A. J. Murphy. "Nature of Defective Laminations in Wrought-Iron Bars and Chain Links." By H. J. Gough and A. J. Murphy. "Effect of Carbon and Silicon on the Growth and Scaling of Grey Cast Iron." By A. L. Norbury and E. Morgan. 2.30 p.m. "Basic Process. Some Considerations of its Possibilities in Enland." By V. Harbord. "Blast-Furnace Data and their Correlation.—Part II." By E. C. Evans, L. Reeve, and M. A. Vernon. "Sub-Crystalline Structure of Ferrite." By C. O. Baninster and W. D. Jones. "Some Alloys for Use at High Temperatures. Complex Iron - Nickel - Chromium Alloys. Part III.—The Effect of Composition and Exposure to High Temperatures." By C. H. M. Jenkins and H. J. Tapsell. The following papers will be presented at this meeting and discussed by correspondence :—"Formation of Ferrite from Austenite." By Sir H. C. H. Carpenter, F.R.S., and J. M. Robertson. "Refractory Materials for the Induction Furnace." By J. H. Chesters and W. J. Rees. "Resistance of Copper-Nickel Steels to Sea Action." By J. Newton Friend and W. West. "X-Ray Investigations on the Crystal Structure of Hardened Steel." By E. Ohman. "X-Ray Investigation of Certain Nickel Steels of Low Thermal Expansion." By G. Phragmen.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

10,290. I. G. Farbenindustrie Akt.-Ges. —Production of esters of carboxylic acids. April 7.

10,725.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of monazo-dyestuffs. April 11.

Specification Published

246,208.—Wulfing, J. A. (Firm of).—Process for manufacturing dilithium alkali citrates.

Abstract Published.

340,114.—Urea-formaldehyde condensation products. Fabriques De Produits De Chimie Organique De Laire, 129, Quai d'Issy, Issy-les-Moulineaux, Seine, Malet, J., 52, Rue des Dames, and Armenault R., 2, Rue Gramme, both in Paris.

The condensation of urea or its derivatives with formaldehyde or its polymers is effected in the presence of zinc or lead carbonate or oxide, bismuth carbonate, a coloured metal carbonate, or titanium oxide. In an example, urea is dissolved in formaldehyde solution, zinc carbonate is added, and the mixture is heated to boiling. After filtering, the reaction product is acidified and evaporated *in vacuo* at a low temperature to a syrup, which is poured into moulds and hardened at 50°-60° C. Specification 181,014, (Class 2, iii, Dyes etc.), is referred to.

The Latest TRADE MARKS

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By the Rev. J. E. Roscoe, M.A.

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COMBINATIONS AMONG CERTAIN DYESTUFF RADICLES.

By M. REBEK.[1]

The present communication is intended as the first contribution upon a series of investigations, some of which have been completed whilst others are still in progress, and which have for their object a study of the combinations of various substituted triphenyl-methane and diphenylamine radicles.

During the last few decades numerous researches have indicated that in certain organic groupings some atoms show abnormal valencies. This is especially the case with carbon and nitrogen in aromatic compounds. Thus, many different aryl-substituted ethanes and hydrazines can be prepared, which tend to split up into the corresponding free radicles or into compounds whose elements exhibit unusual valencies. It was therefore thought of interest to examine the effect of phenyl substitution upon this tendency since it should throw some light upon the nature of the fourth valency of carbon and thereby assist in the elucidation of several problems in organic chemistry. Definite conclusions could not be reached at once owing to the exceptional difficulties associated with this work.

It has been established, however, that in the carbon series the nitro-group favours decomposition; in the nitrogen series, on the other hand, the same group hinders it. The quarternary nitrogen acts like the nitro-group, at least regarding the aryl-hydrazines for the hydrochloride of tetra-[dimethyl-amino]-tetraphenyl-hydrazine is a very stable compound and exhibits no dissociation phenomena.

We have combined basic tritanols (*e.g.* derivates of triphenylmethyl-hydroxide) with acid tritanes (*e.g.*, derivates of triphenylmethane) or diphenylamine hoping that qualitatively and quantitatively different charges on the central atom would lead to compounds, which a physico-chemical examination might permit of conclusions being drawn concerning the passing of polar compounds into non-polar bodies. The possibility of the presence of isomers, a salt

[1] Part of the experiments were made by M. Perpar.

form and an organic form) had also to be considered, since our reactions took place between pseudoacids and pseudobases, *i.e.*, between homopolar substances, whilst the dyeforming process is based on salt-formation from a real acid or base.

The first researches were concerned with the systems from crystal violet base and hexa-nitro-tritanes (*e.g.*, the acid of Aurantia). By warming the nitrobenzene or acetone solutions of the components, definitely crystalline compounds, having the characteristics of dyestuffs, were isolated. They proved to be quite stable, very slightly soluble in water, ether or petroleum ether, but dissolved readily in other orgauic solvents, especially acetone, Acids and bases both decomposed these compounds forming the dye-salt and regenerating one component.

The compounds crystallised with acetone of crystallisation : that from crystal violet base with hexa-nitro-tritane in the form of columns containing three molecules of acetone, whilst the long needles of the product from crystal violet base and hexa-nitro-diphenylamine contained only one molecule of the solvent. Colourless or only slightly coloured "organic" modifications were not obtained; all products were deeply coloured and their acetone solutions conducted the electric current. They reacted vigorously with compounds containing hydrogen or hydroxyl ions. They can be salted out of their acetone solutions by means of common salt, magnesium sulphate or calcium chloride.

The interaction between the carbinols and nitro-compounds was followed by measuring the conductivity changes. We were able to establish that the reactions between the base of crystal violet or the base of fuchsin and hexa-nitro-diphenylamine are instaneous whereas the reaction of the first two and hexa-nitro-tritane necessitated many hours for completion. Under the above experimental conditions the change from crystal violet pseudo-base into the true base was instantaneous, a fact which is noteworthy in view of Hantzsch's fundamental experiments.

The time reaction between crystal violet base and hexa-nitro-tritane can be compared with that of piperidine and hexa-nitro-tritane, which goes very regularly and may be plotted on a curve. The cause of this may be the reaction

Hexa-nitro-tritane⟶aci-hexa-nitro-tritane and

aci-hexa-nitro-tritane + piperidine = piperidinium salt

whereas the system, crystal violet base + hexa-nitro-tritane follow the changes,

pseudo-acid⟶true acid

pseudo-base⟶true base

true base + true acid⟶dye salt + H_2O.

Since the velocity of the formation of the pseudo base from the true base most probably depends upon the concentration of the electro-contrary component, an obvious course of reaction cannot be expeeted.

During the transition the concentration of the sale rises. In order to find the influence of this the change of conductivity of the product from crystal violet base and hexa-nitro-tritane with dilution was studied, using crystal violet as a means of comparison. In both cases there was a gradual increase in the specific conductivity with the formation of the compound molecules, only on great dilution was any irregularity noticed. In any case the reaction curve and the dilution curve were very different.

In order to obtain a preliminary view we investigated the following systems for conductivity changes during the interactions. Time reaction has been established between crystal violet base and *p*-nitrodiphenylamine; tri-anisylcarbinol and hexa-nitro-diphenylamine gave a momentary maximum whilst crystal violet vase and nitromethane showed hardly any rise in conductivity.

For the optical analysis the substances were placed in a colorimeter and spectrograms were taken. At definite dilutions colour changes occurred. Exposures by the Hartley-Baly method gave absorption curves which showed that the dyes from crystal violet base with hexa nitro-tritane and with hexa-nitro-diphenylamine exhibited identical absorptnon in the yellow and green regions. An approximation to Lambert and Beer's law was also observed. (For these investigations, which were made with a new automatic absorptiometer in the physico-chemical institute of the Charles University, Prague, the author is obliged to Dr. R. Brdicka.)

EXPERIMENTAL.

Combination of 2 : 4 : 2′ : 4′ : 2″ : 4″—Hexa-nitro-tritane with the Base of Crystal Violet.

4 : 4′ : 4″—Hexa-methyl-triamino-trityl 2 : 4 : 2′ : 4′ : 2″ : 4″—Hexa-nitro tritane.[2]

The acid nature of hexa-nitro-tritane is but feebly manifested. Its blue colour with alkaline solutions points to the formation of salt-like compounds. It was therefore surprising to obtain a very stable, well-crystallised substance on simply warming molar solutions of crystal violet base and hexa-nitro-tritane.

Molecular proportions of the components are dissolved in pure nitrobenzene or acetone at about 40° C. and the acid constituent then gradually poured into the basic one. The reddish colour of the hexa-methyl-triamino-tritanol changed to dark reddish-brown and continued to deepen in colour. After heating for about an hour at 120-125° C. (in acetone solution the mixture was kept boiling) it became dark blue. After two hours, the reaction product was treated with ether and the residue was filtered off. The residue was re-dissolved in acetone and again precipitated with ether. Small green crystals with a golden glance were obtained. On re-crystallisation from acetone, large and well-formed crystals could be isolated. Solutions of electrolytes precipitated the substance from acetone solution as a dark crystalline precipitate.

The compound was also prepared by melting the components together.

It was insoluble in water, ligroin and ether, but dissolved readily in methyl alcohol, benzene, chloroform and acetone. The acetone solution appears red in reflected light but dark blue in transmitted light. With alcoholic caustic potash the blue colour was retained although the fluorescence disappeared. Acids turned the colour to green. A dry chloroform solution of iodine yielded a beautiful crystalline product. On analysis

0.1080 gram of the substance gave 0.0535 gr H_2O and 0.2372 gr CO_2;
0.1166 ,, ,, ,, ,, 0.0571 gr H_2O and 0.2568 gr CO_2;
$C_{44}H_{39}O_{12}N_9+3C_3H_6O$ calculated, C = 60.03; H = 5.42,
found, C = 59.90, H = 5.55,
60.07 5.48

The combination of 2 : 4 : 6 : 2′ : 4′ : 6′—hexa-nitro-diphenylamine with fuchsine base gave 4 : 4′ : 4″—triamino-trityl—2 : 4 : 6 : 2′ : 4′ : 6′—hexa-nitrodiphenylamine.

The systems, crystal violet base with hexa-nitro-triphenylmethane, hexa-nitro-diphenylamine in acetone and in nitrobenzene were also investigated.

The Organic Laboratory of the Chemical Institute,

The King Alexander University, Ljubljana, Jugoslavia.

—(Abstracted from the *Collection of Czechoslovak Chemical Communications.*)

INFLUENCE OF INTERNAL TRANSVERSE MAGNETISM ON ELECTRICAL RESISTANCE OF NICKEL AND NICKEL-IRON ALLOYS.

The transverse magnetism produced in a wire by the passage of an electric current affects the resistance of the wire, but the effect tends to disappear after a time. In the case of iron, an increase of resistance is produced by the transverse magnetic field; this gradually decreases; iron which has been previously heated shows an opposite effect. With nickel and nickel-iron alloys, both before and after heating, transverse magnetism produces a decrease in eletrical resistance. Alloys containing 44 and 49 per cent. of nickel lose their magnetism in a short time, in the 36 per cent. alloy the effect is more protracted, while the 22 per cent. alloy returns rapidly to its original state. In all the alloys the change in resistance is proportional to the intensity of the current used to produce the transverse magnetism.

[2] This notation is suggested on the grounds of simplicity without supporting any special theory.

THE USE OF SELENIUM.

by T. L. Garner, M.Sc., D.I.C.

The relationship between oxygen, sulphur and selenium is well known, but while oxygen and sulphur have long been relatively cheap commercial products, selenium has only been available at a price which is for many purposes prohibitive. This position must continue to exist until sufficient new uses are discovered to make a cheaper production possible, but the potential production is much above the total at present required. Considerable activity has been noted in research to discover new fields of application, but, in general, success has been in the medicinal or chemical industries, with a small aggregate amount required. If a really big opening for this element could be found, the quantities produced could be largely increased, since at present only small demand prevents the working-up of residues from copper and lead refining processes, in which selenium is to be found.

Selenium is isomorphous with sulphur and like the latter, exhibits three known allotropic modifications: (1) Amorphous, formed as a fine red precipitate when sulphur dioxide is passed through a solution of selenious acid, (2) Vitreous, formed when amorphous selenium is heated to about 217°C. and rapidly cooled. This variety is a black, brittle, lustrous substance which softens at 100°C. and is molten at 250°C., but exhibits no definite melting point, (3) Metallic selenium is obtained when the vitreous variety is heated to 210°C. for some time, when the mass suddenly melts and metallic selenium is deposited on cooling as steel-grey, hexagonal crystals. This change takes place at lower temperatures in a longer time. Only metallic selenium will conduct electricity, and it is, therefore, the only variety suitable for use in selenium cells. An important property of selenium is the lowering of its electrical resistance upon exposure to light; the action is principally produced by the red rays and is proportional to the intensity of the light. However, since the change is not instantaneous, selenium compares unfavourably with the potassium photo-electric cell, although the latter is considerably more costly.

Use in Rubber Manufacture.

For this purpose the selenium used is the steel-grey modification which is insoluble in carbon disulphide. It has been known for many years that selenium will effect vulcanisation in a similar manner to sulphur, but in recent years it has been established that using it as an additional compound to sulphur in a rubber mixing, very definite properties are imparted to the finished product. The most important property claimed when selenium is used in conjunction with sulphur and an accelerator, is toughening of the vulcanised rubber, together with increased hardness and resistance to abrasion. The usual amount recommended is about one per cent., based on the percentage of rubber in the mixing, and if slightly more is used, the rubber after vulcanisation will show a characteristic greenish bloom of selenium. It is claimed that its use reduces the tendency of sulphur to bloom out of unvulcanised rubber, by presenting crystals, which are amorphous with sulphur, and so cause uniform internal crystallisation of sulphur. The use of larger amounts of selenium, about eight per cent. on the rubber is recommended for the preparation of flame proof rubber goods.

In addition to the use of selenium itself, many patents have been granted for the use of its compounds. For example, selenium diethyldithiocarbonate is an accelerator of vulcanisation very similar to tetramethylthiuram disulphide in its action, and when used in a sufficient percentage can effect vulcanisation without requiring the presence of sulphur.

Selenium Cell.

The conductivity of electricity by selenium is dependent on the intensity of the light, and this characteristic property has lead to the development of the selenium cell. Such cells are used industrially in many ways, for example, in the self-lighting buoy, control apparatus for chimney draught, the control of the progress of sulphuric acid manufacture by the contact process, and many other purposes, but its use is limited to some extent by the fact that the recovery of its absolute resistance upon change from light to dark is not instantaneous. There has been improvement in this connection of recent years, however, but in competition are the potassium photoelectric cell and the copper oxide cell.

General Uses.

Selenium oxychloride, which is a heavy, almost colourless liquid, is a very powerful solvent. The synthetic resins which now are the basis of a large and growing industry, were formerly regarded as being insolu-

ble, but they are readily soluble in selenium oxychloride; this solvent may be used more extensively as its value in this connection becomes more fully realised.

Perhaps the principal use of selenium and its compounds, at least as regards quantity, is as a decolouriser in the glass industry and in the manufacture of ruby glass. In the former connection it is used to neutralise the green tint imparted by traces of iron, and in the latter for the production of danger signals, etc. Another important use is the flameproofing of electric switchboard cables, where short circuits are occasionally caused by the collection of dust, resulting in the firing of part of the cable covering. If, however, the cable is treated with a thin layer of metallic selenium, a remarkable flameproofing is effected. The use of fine-drawn selenium wire is extending to some extent, wires with as small diameters as one millimeter to one micron being possible.

Until, however, some new use is discovered which will absorb a considerable amount of selenium there does not seem to be any possibility of a material reduction in the cost of the raw material. In 1927 the price ranged around about 8s. a pound but this was increased in 1928 to about 9s. a pound, the price today being back again to the region of 8s.

ESSENTIALS IN PHOTOGRAPHY.

Photography today is a far simpler thing than it was. Few, however, really appreciate how extremely easy it is.

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Perhaps none but Burroughs Wellcome and Company could condense so much into 12 pages, but then they are adepts in the art of compression, as witness the "Tabloid" products for which they are famous. The booklet is fascinating artistic, as everything photographic deserves to be, but it it also intensely practical. A copy can be obtained gratis by application to the publishers, addressed G.P.O. Box No. 213a, London.

HIGH-TEMPERATURE MECHANICAL PROPERTIES OF NICKEL-CHROMIUM STEELS.

In view of the length of time involved in long-time "creep" testing, and of the probability that a large amount of valuable preliminary information may be obtained by means of short-time high-temperature tests, a study has been made of the short-time tensile properties of a variety of materials at temperatures varying over the range 70°-1360° F (20°-740° C). The steels tested cover a somewhat wide range of composition, being selected primarily with a view to showing the effects of certain alloy elements on high temperature properties; they include steels of the following classes: —chromium-vanadium, chromium-vanadium-tungsten, chromium-tungsten, nickel-chromium molybdenum, and austentic steels containing high nickel and chromium with or without tungsten. In the case of three of the high nickel-high chromium alloys, results of high-temperature creep tests were already available and these were used as a basis of comparison of the properties of materials as determined by "short" —and "long-time" tests.

Detailed examination was made of the structure of the alloys before and after testing and in addition, hardness was determined, as an indication of possible tempering effects produced during heating for test.

The results fully confirm the superiority of alloy steels over carbon steels for high-temperature service; the proportional limit of the carbon steel at elevated temperatures was very much lower than that of any of the alloy steels at corresponding temperatures, and, when stressed beyond the elastic limit, the alloy steels show a stress-strain curve which deviates much less from a straight line than that given by the carbon steel.

Comparison of the values obtained for "short-time" and "creep" tests on identical materials indicate that the former test cannot satisfactorily replace the "flow" test as a criterion of the load-bearing capacity of steels at high temperatures.

CANADA'S NICKEL PRODUCTION.

The nickel production of Canada constitutes about 90 per cent. of the world's output.

THE ECONOMY OF MACHINE PRODUCTION IN AGRICULTURE.

The economic welfare of Canada is so closely related to the conditions of the agricultural industry that the revolutionary changes taking place recently in that industry are of paramount importance. The development of the gasoline tractor, and, more recently, the introduction of the combine into Western Canada have resulted in radical changes in the technique of production, and the present depression through which agriculture is passing, has stimulated interest in the mechanization of farming. Two methods of meeting the existing situation are commonly under discussion, viz., rationalization and stabilization. Stabilization of prices is being advocated as a method of protecting grain producers from the adverse effects of the depression. Rationalization refers to a process by which producers may adjust the internal management of the farm to present circumstances and safeguard their farm business againt similar occurrences in the future. The former is a doubtful temporary expedient, the latter a permanent change calculated to secure stability for the industry by adaption to the recent improvements in agricultural machinery.

The development of agricultural machinery has been most rapid since the beginning of the nineteenth century. Prior to that time, the agriculturists had at their disposal a variety of tools, mainly for cultural purposes, but it was not until about 1830 that there was suficient diversity of equipment to justify the term, agricultural machinery. Following the advent of the reaper, machines for agricultural purposes were being introduced so rapidly that 1850 is recorded by historians as the beginning of the machine era in American agriculture. Since then the important inventions of the binder, the gasoline tractor and the combine have brought with them implements adapted to all phases of agricultural operations.

Many factors, through their influence on agriculture, have been effective in stimulating the use of machinery. The growth of civilisation and the development of trade, both national and international, led up to the industrial revolution which profoundedly affected the entire economic organization and revolutionized agricultural production. The growth of agriculture under a commercial economy received new impetus with the expansion of population on to the dark-coloured soils and this factor combined with the development of transportation facilities, enabled the products of North America agriculturists to enter world markets. To compete successfully in these markets with products from other areas of expanding production and permit an advancing standard of living has necissitated the adoption of an agricultural organization, making possible a high degree of productivity per worker. In this process machinery has been the controlling force. At times expansion has been inhibited by the absence of adequate equipment, but where the demand has become suficiently urgent ,the invention of some new and more efficient machine has permitted rapid development.

The effect of invention is cumulative and the major improvements bave been accompanied by a complexity of minor machines, all contributing to more efficient production methods. The acceptance of these innivations by the farming community has required constant reconstruction of farm organization, and during periods of transition maladjustments have been inevitable. this is the price that must be paid for progress. The problem is to secure the adjustments with as little loss as possible.

In the past, this growing utilization of machinery has testified to its economy. As part of an economic process the increased mechanization of agriculture is inevitable.

Some improvements in farm machinery exert their influence on the existing farm unit. Snch machines as feed carriers, mechanical milkers, manure carriers, stationary gas engines, etc., lighten the labour on the farm and save time. The use of improved machinery results in more efficient execution of farm operations. Manure spreaders permit more economical utilization of animal refuse; silage cutters and feed grinders eliminate waste in feeding. Improved tillage machines and seed drills control weeds, secure a better seed bed, more uniform seeding at a more even depth and result in higher yields. Spraying machines for orchards and potato fields increase yields, and machines for dusting cotton and handling corn forage are instrumental in meeting emergencies occasioned by the attacks of the boll-weevil and the corn-borer. Modern hay-making machinery enables the farmer to take advantage of favourable weather and prevents deterioration of the crop; and dairy equipment—

separators, testers, refrigerators, churns and butter-workers—improve the quality of the product.

By saving time and labour, reducing losses and increasing the production of better quality products on the individual farm, machinery secures increased returns to the operator.

Other improvements enable the available labour force to operate a large acreage and can be used more economically on units larger than those previously existing. Where tractors, combines, corn pickers, cotton sleds, two-row cultivators, etc., are introduced, a change in the farm organization is necessary.

Equipment of this kind has resulted in an enormous saving in time and labour. A tractor operator with a five-bottom 14″ plough can turn over more land in one hour than the same man with a walking plough could cover in a day. Ten days of one man's time are required with a one-horse outfit to cultivate the same acreage that the four-row outfit can cultivate in one day. In 1830, with hand production methods, 32 hours of man labour were required to produce 10 bushels of wheat. In Montana an acre of land has been summer-fallowed and a crop of wheat removed the following year with $2\frac{1}{2}$ hours of man labour. Modern machinery has reduced the labour of husking and cribbing corn 20 to 30 hours per acre. The labour in 1 ton of hay in bales was reduced between 1860 and 1894 from $35\frac{1}{2}$ hours to $11\frac{1}{3}$ hours.

This reduction in labour has resulted in a larger acreage operated per worker. Since 1850 the average acres of improved land per worker in the United States has increased steadily from 30 acres to 49 acres in 1925, and the figures for Canada show that between 1881 and 1891, acres of farm land per worker increased 95 per cent., improved land per worker 105 per cent. and crop acres per worker 109 per cent.

This tendency has resulted in an increased productivity of those employed in agriculture. The American farm worker produces about three times as much as does similar worker in important European countries.

Not only may the farmer increase his physical volume of production by the use of machine methods, but, where the farm organization is adapted to the new equipment, operating costs per unit of product may be reduced. According to North Dakota figures "the combine method saves approximately \$1.75 per acre when 600 acres are straight combined and about \$1.25 when the crop is windrowed and picked up."

The ability to save labour, extend the crop acreage, increase production and at the same time reduce costs enables the individual farmer to secure higher net income. C. D. Kinsman says of conditions in the United States: "In general the farm operators in the States having a high utilization of power per worker are shown to have a correspondingly high net income. This circumstance would indicate that the extensive use of power and labour-saving equipment, if effectively employed, is extremely profitable." That Canadian producers have also profited by the adoption of machine methods is indicated by the fact that whereas the average value of goods produced by each farm worker amounted to \$509 in 1901, this had increased to \$1340 in 1921, or by 163 per cent.

The relatively high standard of living found among agriculturists on this continent, in comparison with conditions in European or Asiatic countries, is maintained largely through the benefits of improved machinery.

Grain farming is pre-eminently adapted to machine methods of production and conditions in Canada favour that type of agriculture. Approximately two-thirds of the agricultural land devoted to field crops is in the prairie provinces, where topography, climate and soil are conducive to extensive methods. These conditions are accentuated by the relative abundance of land, and the small population which makes labour scarce and necessitates producing for distant markets.

For these reasons agriculture in Canada has developed through the utilization of machinery and a steady increase in the size of farms. Past history and present experience demonstrate that success in mechanized farming can be achieved only by adapting the farm to the improved equipment.

The introduction of machinery in agriculture, which made possible the transition from self-sufficing to commercial economy, resulted in regional specialization in production. The production of various agricultural commodities became concentrated in areas in which conditions were most suitable and so in the United States there developed the cotton belt, corn belt, wheat belt and dairy belt. Similar development

in this country has been stimulated by farm equipment and the division of labour has increased the efficiency of production.

The reduction of operating costs made possible by more efficient machinery has resulted *in the extension of the margin of* cultivation and increased agricultural production by the expansion of the acreagae under cultivation.

An important effect of machinery in agriculture has been the reduction of the proportion of total population engaged in that industry. This has been evident both in the United States and in Canada. In 1820 the United States Census reported about 88 per cent. of all gainfully employed persons as engaged in agriculture; by 1850 the percentage had decreased to 80 per cent.; by 1870 to 47.6 per cent.; by 1900 to 35.7 per cent. and by 1920 scarcely 25 per cent. were so reported. Dr. Erdman points out two *interesting phenomena which arose in spite* of this marked reduction in the percentage of the nation's workers employed in agriculture: first, growing complaints about over-production of agricultural produce, and second,—a tribute to the inconsistency of our thinking—discussion about the danger which faced that nation because farmers were leaving their jobs. In Canada the percentage of the population engaged in agriculture has steadily declined. The vgures are 1181, 48.1 per cent.; 1891, 45.8 per cent.; 1901, 40.2 per cent.; 1911, 34.3 per cent.; 1921, 32.8 per cent. During this period the surplus of agricultural exports over imports increased 600 per cent.

The *increased efficiency of the average* farm worker enables industry to grow. Without machinery, the workers necessary to feed and help clothe a rapidly increasing population would require an almost equal increase in agricultural workers. Industry, to supply other wants than the bare necessities of life, is dependent on the food surplus of the farmer over and above his own consumption requirements. The amount of the surplus depends on the productivity of the individual worker, and this can best be increased by the replacement of manual labour by machine methods. Through the increasing use of machinery and scientific improvements in technique the total agriculture production in the United States is no greater per capita of total population than it was fifty years ago, while the per capita *production of manufactured commodities* has doubled and the per capita production of mining has trebled in the *same period.*

Canadian agriculture is passing through a period of transition. The rapid increase in *the efficiency of inaminate power machines*, and the combine, which tractors have made possible, are slowly revolutionizing grain production on the prairies and the effect is being felt in all phases of the industry. Sales of tractors and combines demonstrate their growing use, and to secure the advantages of these machines reconstruction of farm organization is necessary. It has been authoratively stated that successful combine operators in Saskatchewan are those who adjust their farming methods to the use of the machines, and the prime necessity for economical operation of both tractors and combines in a larger acreage than is fonnd on the average horse and binder farm.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Centenary.

On the occasion of the Centenary of its foundation, which will be celebrated in London in September (23-30), the British Association aims at raising a fund which not only will cover all necessary and desirable expenditure in connection with the Centenary Meeting, but also will assure for the future an adequate financial basis upon which to develop its approved activities.

The total sum which is the Association's objective is £40,000.

During the century of its existence the Association has striven—

To extend general interest in Science and its applications.

To promote intercourse between those engaged in scientific work in all its branches.

To initiate and encourage scientific research.

These objects have been achieved—

By holding Annual Meetings in principal cities of the United Kingdom and in the Dominions.

By appointing committees to carry out or supervise research, or to watch and report upon the state and progress of science.

By *publishing the annual addresses* delivered by the presidents of the Association and sectional presidents, reports on the state of science and on individual

- researches, abstracts of lectures and papers, etc.

By addressing resolutions and recommendations to Government departments, administrative authorities, kindred scientific institutions, etc., with the object of ensuring common action or otherwise encouraging scientific development.

In 1929 H.R.H. The Prince of Wales honoured the Association by accepting its Presidency for the Oxford Meeting.

In 1928 the Association received the Royal Charter of Incorporation.

In 1929 the Association, through the liberality of Mr. George Buckston Browne, F.R.C.S., came into possession of Down House, the Kentish home of Charles Darwin, which was vested in the Association by the donor in custody for the nation, and is maintained as a memorial. Thereby was discovered a new and unforeseen, but wholly appropriate, extension of the Association's responsibility and work.

Research.

Some of the researches initiated and supported hy the Association have been of national or more than national importance. For instance : the standards of electrical measurements now in international use are based upon the work of a British Association committee. The care of the national standards and the issue of certificates of accuracy are now vested in the National Physical Laboratory. This important Government institution was first established in Kew Observatory, which previously, for thirty years, had been maintained at the charge of the British Association after the Government in 1841 had decided to dismantle it.

In spite of the more ample endowment of scientific research by the State and through other channels of recent years, there is every reason why the support of research by the Association should be maintained. The desirability of any given piece of research work is demonstrated if it emerges from discussion at an Association meeting, as this is an assurance that the best scientific opinion has been brought to bear npon it, and this assurance is reinforced if the Association is able, and sees fit, to support the work by a grant. The Association's grants are expended upon materials and instruments, and its income largely upon the publication of the results of research.

GENERAL NOTES

THE CHEMICAL, ENGINEERING, IRON AND STEEL INDUSTRIES.

Chemicals.—There has been a decidec improvement in the general tone of the chemical market this month, orders ir nearly all sections being more numerous although still for rather small quantities Heavy chemical business has been moder ately satisfactory. Cornish arsenic ha been very firm, due chiefly to its scarcity supplies being very difficult to obtain Acetic acid and acetone have been in goo demand, but caustic potash has been doin very poor business. The formaldehyde mar ket has been very keen, but the demand i fairly satisfactory. Refined coal tar is agai one of the best items among coal product and export enquiries for pitch have bee more numerous.

The pharmaceutical market shows fe changes. Citric and tartaric acids are sti doing poor business, while aspirin an methyl and sodium salicytates report bris sales. Sodium potassium tartrate and la tic acid were both reduced in price. Make have decided not to increase the price bismuth salts, in spite of the advance of 6 a pound in bismuth metal. The essenti oil market has improved steadily, and man items are firmer.

Iron and Steel.—There are no signs improvement in the iron and steel trades Sheffield, and although only one-third the open hearth furnaces are working dif culty is being experienced in disposing the reduced output. Export figures f February show a further decline in overse trade. In Middlesbrough there is a slig improvement in enquiries for forward bu ness. Stocks of Midland pig iron are hea and the outlook continues unpromising.

The production in the tinplate indust in South Wales is 50 per cent. belc capacity. Some hopes are centred on t continued expansion of the fruit and veg table canning industry in this country.

March production of pig iron amount to 357,100 tons compared with 318,200 February and 665,800 tons in March, 193 Steel ingots and castings reached 500,1 tons compared with 486,400 tons in Febr ary and 826,100 in March, 1930.

Engineering.—In the engineering tra at Bristol the general position is regard as fair, and there is a slight tendency wards improvement in some directions.

Sheffield certain branches of the tool trades show a slight improvement. The Home demand for twist drills, cutters, joiners and farm tools has improved, but exports are lower than they have been for many years. The file trade shows more activity, and the hackshaw branch business is fairly good. A northern firm has secured the order for a new bridge across the Tees at Newport, the amount being £436,913.

OFFICIAL TESTS FOR ELECTRICAL APPARATUS IN MINES.

The Secretary for Mines announces that he has decided to institute official safety tests for electrical apparatus intended for use in mines where, although the normal conditions are considered sufficiently safe to permit the use of electricity, it is, nevertheless, necessary to take precautions against an explosion of firedamp.

The object of these tests is, briefly, to determine by actual explosion experiment whether the electrical apparatus under test is "flameproof"—that is to say, whether the design and construction are such as will securely prevent the ignition of a small quantity of firedamp inside the apparatus from giving rise to an explosion of firedamp outside it.

By arrangement with the Safety in Mines Research Board, and with the help of their staff, a new Testing Station for this work has been erected and equipped by the Mines Department at Harpur Hill, Buxton, adjoining the Board's Research Station there (the new Station was to be ready for work by the middle of April).

All enquiries and all applications for tests which, so far as possible, will be dealt with in the order in which they are received, should be addressed to the Under-Secretary for Mines, Mines Department, Dean Stanley Street, London, S.W.1.

It is understood that, in view of the institution of these official tests, the University of Sheffield has decided to discontinue the unofficial tests of the same character in the carrying out of which for some years past it has rendered valuable services to the safe development of the use of electricity in the mines of this country.

CANADIAN COPPER ORE.

Copper ores of various kinds, including the native metal, are found at many places throughout Canada, but only the sulphide ores are commercially important.

SAFETY IN THE CHEMICAL INDUSTRY.

The Association of British Chemical Manufacturers and the Chemical and Allied Employers' Federation working through the Works Technical Committee of the former Body, has decided to organise a Chemical Session in connection with the Safety Week of the National Safety First Association, which is to be held in Leeds from 11-16 May, 1931. The whole of the morning of Tuesday 12 May from 10.30 a.m. onwards will be devoted to the Chemical Session. The Chair will be taken by Dr. E. F. Armstrong, Chairman of the Association of British Chemical Manufacturers and of its Works Technical Committee, who will in his introductory remarks draw attention to the work on which the Association is now so active in regard to safety in the chemical industry, and to the Model Safety Rules, Safety Circulars and Safety Summaries which are now a regular feature of the Association's activities. The Chemical Session will be open not only to members of the chemical and allied industries but to representatives of all firms which are members of the National Safety First Association. A subject of wide interest has therefore been chosen, namely the cleaning and repair of vessels containing dangerous materials, as this is a problem which affects practically every industry in some form or other. Furthermore, ignorance of the principles to be observed has been responsible for numerous accidents in the past—unfortunately many of them fatal—and it is therefore highly desirable in the interests of safety that the procedure to be followed should be known and appreciated as widely as possible. Special attention will be given to the methods of cleaning and repairing plant and vessels where it is necessary for workmen to enter a confined space in order to perform the allotted task, as these are the conditions under which accidents are most liable to occur.

The Paper will be presented by Mr. J. Davidson Pratt, the General Manager of the Association of British Chemical Manufacturers. It will be printed by the National Safety First Association and copies will be distributed before the meeting to all members of these two Associations, and to any other individuals or firms who make application to either organisation. This will permit of the Paper being read in abstract, so that the greater part of the Session will be

devoted to a discussion for which a number of speakers representing the various branches of the chemical industry will be arranged.

This will be a unique occasion as it will be the first Chemical Session in connection with the National Safety First movement. The meeting should therefore be well attended, and since everyone may join in the Discussion, it should prove a valuable opportunity for the consideration of this important safety problem.

HONDURAS.

Methods of Trading and the Appointment of Agents.

A confidential memorandum on Methods of Trading and the Appointment of Agents in Honduras prepared by His Majesty's Consul at Tegucigalpa has been received in the Department and issued to firms whose names are entered on its Special Register.

British firms who desire to obtain a copy of the memorandum together with particulars of the Special Register Service of information should apply to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number C.X. 2506 should be quoted.

IRISH FREE STATE TARIFF.

Information has been received that an alteration has been made in the Irish Customs Duty on woollen textiles. Hitherto duty has only been payable when materials were of a value of 2s. 6d. per square yard or more. This figure has now been altered to 2s., thereby making lower qualities of materials dutiable. A notice with regard to this matter has been sent to the Bradford District, and certain firms who made specific enquiries have been informed direct.

BRITISH DRUG HOUSES, LIMITED.

The trading profit for 1930 amounted to £58,086, against £71,610, the net profit being £40,002, against £58,504. Reserve received £10,000, compared with £15,000, the preference dividend absorbed £12,000, a final dividend of 3 per cent. has been recommended on the ordinary shares, making 5 per cent. (against 8 per cent.) leaving £8,330 to be carried forward with £10,428 brought in.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, April 30.

Determination of the Yard in Wave-lengths of Light. By A. E. H. Tutton, F.R.S.

The author has carried out a determination of the number of wave-lengths of the red light radiations of hydrogen (H_a) and cadmium (Cd_r), and of the yellow radiations of neon (Ne_e), in the British Imperial Standard Yard, and by an original method quite different from the methods by which Michelson in 1892-3, and Benoit, Fabry and Perot in 1907 evaluated the French metre. A base-line of ten-thousand (9,675 in H_a and 10,850 in Ne_e) half-wave-length interference bands has been actually counted, those contained in the one-eighth of an inch, between defining lines which are themselves less than a single wave-length in thickness, specially ruled for the purpose by the late Professor H. J. Grayson. This portion of the work, which required some years of practice before it could be successfully accomplished, has been carried out in Cambridge on the author's interferometer (described to the Royal Society in 1923), and the remainder on the Tutton Comparator (described in 1909) at the Standards Department of the Board of Trade. This latter part consisted in stepping off from the counted base line by repeated adjacent duplications and (by their addition) doublings, to larger and larger intervals, namely, $\frac{1}{4}''$, $\frac{1}{2}''$, $1''$, $1\frac{1}{8}''$, $2\frac{1}{4}''$, $4\frac{1}{2}''$, $9''$, $18''$, and the yard, the intervals being each defined by Grayson wave-length rulings (the central ruling of five, spaced at one-forty-thousandth of an inch apart, being the fiducial mark in each case). All the minute differences between intended duplicate intervals were determined in interference bands.

The final result is that the Imperial Standard Yard, at the official temperature 62° Fahrenheit and 760 mm. barometric pressure, is found to comprise 1,420,210.[illegible] wave-lengths of the standard red lines of cadmium, Cd, 1,562,408.6 wave-lengths of the yellow nean line Ne_e, and 1,393,266.[illegible] wave-lengths of the red hydrogen line H_a. Instead of relying on direct determinations with cadmium light, to produce which the vacuum tube has to be heated to 340° C. which was found gravely to affect the thermal equilibrium and thereby the accur-

acy of the observations, the direct determinations with H_α (which is very close to Cd_r) and Ne_α were used to calculate the value for Cd_r; the two independent values thus obtained for Cd_r were 1,420,210.8 and 1,420,209.8, an agreement which gives every confidence that the round number 1,420,210 is very near the truth. The author suggests that this round number might be taken as the length of the British yard.

The Velocity of Corrosion from the Electrochemical Standpoint. By U. R. EVANS, L. C. BANNISTER AND S. C. BRITTON. Communicated by Sir Harold Carpenter, F.R.S.

By excluding oxygen from the anodic areas, it has been found possible to tap and measure the whole of the electric current responsible for the corrosion of iron; the coulombs measured are equivalent, in the sense of Faraday's law; to the corrosion actually produced, indicating that the whole attack is of an electrochemical character; this equivalence has been found not only in cases where the anodic and cathodic areas consist of different substances, but also in the commoner case of "differential aeration attack," where the whole specimen consists of one metal, the potential difference being set up by the distribution of oxygen. The problem of corrosion velocity thus resolves itself into determining the laws which govern the strength of this current.

The current can never exceed that limiting valne which would cause so much polarisation as to make the cathodic and anodic potentials equal; such "equipotential" conditions are closely approached at high salt concentrations; at low concentrations, however, a considerable residual E.M.F. is needed to force the current over the resistance of the circuit.

Most of the polarisation occurs at the cathodic area, and a number of cathodic polarisation curves have been traced. The law governing the ratio of anodic and cathodic areas has been established: the anodic area extends until the cathodic current density reaches the "protective value" requisite to prevent further extension. The nature of cathodic protection, and of other methods of inhibiting corrosion, is discussed.

On the Connection Between the Ray Theory of Electric Waves and Dynamics. By T. L. ECKERSLEY. Communicated by W. H. Eccles, F.R.S.

There is a very close analogy between the analytical description of the transmission of such electro-magnetic waves and Schrödinger's wave theory of quantum dynamics. Optical ray methods are often used in the analysis of wireless wave transmission and the rays can be given a dynamical interpretation as the orbits of a group of waves (considered as a particle).

The approximate ray method of analysis bears the same reltionship to the true wave method that the Newtonian dynamics bears to the new wave mechanics. The wireless ray theory fails when the radius of curva ture of the rays becomes comparable with the wave-length, in just the same way that, for instance, the Newtonian dynamics of an electron wails when the orbit becomes of atomic dimensions comparable with the wave-length of the ψ-waves.

When determining solutions for a limited region, the boundary conditions impose definite limitations which result in the selection of a definite set of "Proper Values" or "Eigen Values." These correspond with the definite "Eigen Values" of the analogous quantum case. Corresponding to the energy levels in the latter case we have a discrete set of direction cosines l, m, n of the possible waves.

Papers read in Title only :—

On a Night Sky of Exceptional Brightness, and on the distinction between the Polar Aurora and the Night Sky. By LORD RAYLEIGH, F.R.S.

An exceptionally bright night sky on November 8, 1929, is described, with photometric observations. It was of about four times the ordinary brightness, and eight times the minimum ever observed. It was of the same chromatic constitution as usual, and the aurora line was not conspicuous. There was no accompanying magnetic disturbance. This is contrasted in detail with the aurora of May 14, 1921.

Spectra of the aurora and of the normal night sky are reproduced for comparison. Nitrogen bands are absent in the latter.

Two unidentified bright lines in the night sky spectrum are re-measured. The wavelengths found are 4419 and 4168.

The Wave Resistance of a Spheroid. By T. H. HAVELOCK, F.R.S.

It is shown how to calculate the wave resistance of an ellipsoid submerged in water and moving horizontally in any orientation. Explicit results are given for prolate and oblate spheroids moving in the direction of the axis of symmetry, and at right angles to that axis: these results are illustrated by graphs of the variation of wave resistance with velocity for a series of spheroids of varying eccentricity when moving end-on

and also when moving broadside-on.

On Periodicity in Series of Related Terms. By SIR GILBERT WALKER, F.R.S.

Viscosity and Rigidity in Suspensions of Fine Particles. I, II. By C. M. MCDOWELL AND F. L. USHER. Communicated by R. Whytlaw-Gray, F.R.S.

The anomalous behaviour of certain colloidal solutions of the lyophilic type, when subjected to shearing forces, has been explained in a variety of ways, all of which, however, rest on one of two basic assumptions : either that there is an increase in the effective volume of the disperse phase in consequence of extensive solvation of its ultimate physical units (molecules or molecular aggregates), or that these units are linked together so as to form an elastic structure. There appears to be no direct method of deciding between these two hypotheses in the case of lyophilic sols in which the particles are amicroscopic, but the discovery by Hatschek that suspensions of starch grains in an organic liquid show similar anomalies has indicated the possibility of testing the assumptions by direct observation.

In the work now described lyophobic suspensions of charged particles in an aqueous liquid have been used. Experiments on the variation of viscosity with the rate of shear, and of rigidity in these suspensions have been carried out, and the results correlated with the presence or absence of an electrolyte. It is inferred that in suspensions of this type variation of viscosity with rate of shear is dependent on the formation of aggregates, whilst rigidity depends on the linking of the aggregates to form a continuous structure.

On Twisted Cubic Curves Which Satisfy Twelve Conditions. By J. A. TODD. Communicated by H. F. Baker, F.R.S.

The paper deals with the problem of determining the number of twisted cubic curves in space which satisfy the joint condition of meeting r lines in one point, s lines in two points, and of passing through t fixed points where $r+s+2t=12$, so that the condition determines a finite number of curves. Tht simpler cases are trtated by a variety of elementary methods, of which the most interesting and useful is the application of certain Cremona transformations of space which transform the cubics into lines which can be determined without difficulty. For the more complicated cases *the principle of special position is employed,* in which the given lines and points are made to assume particular positions in such a manner that the curves which are required fall into various classes, of which the number of curves in each is determined by simpler considerations. In most cases the results are obtained by two or more such specialisations, and this affords a useful verification of the accuracy of the work. A complete table of the number of curves satisfying conditions of this type, and other conditions related to them, is given. The majority of the results in this table have not appeared before.

A Metrical Theory and its Relation to the Charges and Masses of the Electron and Proton. By H. T. FLINT. Communicated by O. W. Richardson, F.R.S.

This paper points out the analogy existing between the equations of the quantum theory and the electromagnetic equations of Maxwell. This analogy, in conjunction with the results of earlier work, points to the the existence of a definite natural metric in a five-dimensional continuum.

Parallel displacements along the world lines in this continuum are associated with no change in length, but in the four-dimensional world the change of length is a periodic function, with a frequency proportional to the mass associated with the world line.

This view leads at once to the interpretation of the ratio of the masses of the electron proton as a metrical ratio, and makes a unitary physical theory possible.

The principle of conservation of momentum is extended, and shows how an electron proton, although particles of definite rest mass, may unite to form a photon of zero rest mass.

Material and Radiational Waves. By A. M. MOSHARRAFA. Communicated by O. W. Richardson, F.R.S.

The Maxwellian equations of electromagnetic and electron theory are derived from one set of basic relations in a manner which throws some light on the relationship between material and radiational waves, and accounts for the existence of exactly three types of physical entities, namely : positive electricity, negative electricity and radiation. It is shown that a physical entity may be associated with the propagation of a vector A in a direction n. If A and n are in the same direction, the entity is recognised as positive electricity, if in opfosite directions as negative electricity, and if mutually perpendicular, then as radiation. In the general case A will have both a longitudinal and a transverse component, corresponding to the co-existence of matter and radiation.

NOTICES OF BOOKS.

Organic Chemistry for Medical, Intermediate Science and Pharmeceutical Students by Dr. A. Killen Macbeth, M.A., F.I.C. Second Edition. Pp. xiv+296. London : Longmans, Green and Company. 1931. Price 6s. 6d.

This book for beginners in organic chemistry is intended to supplement the student's theoretical and practical courses in the subject. It is not intended to supplant other textbooks but to serve as an introduction to the more comprehensive treatises. The author has endeavoured to anticipate the difficulties the student is likely to encounter in beginning a study of organic compounds after a grounding in inorganic chemistry.

Organic chemistry is definitely associated with biological processes and therefore the author has kept in mind the requiremeots of students of medicine and pharmacy. Instead of an array of facts the subject is presented as an embodiment of general principles and natural laws.

Dr. Macbeth's volume can therefore be highly commended to both lecturers and students.

The Power and Fuel Bulletin is a new journal to be issued monthly by the British National Committee, World Power Conference. (Annual subscription 10s.; U.S.A. and Canada $2.75.)

The World Power Conference, recognising the need for a comprehensive and authoritative survey of current information on Power, Fuel and related subjects, has arranged for the publication of the first international bibliography in this field.

The British Section of the Bulletin will be published on the 25th of each month. The first number, for January, 1931, was published on 25th February. The Bulletin will aim at providing *selective and up-to-date* abstracts of books, papers, articles, etc., on Power and Fuel, published in this country and grouped under the following main headings :

(*a*) Sources.

(*b*) Generation.

(*c*) Distribution and Storage.

(*d*) Utilisation.

The Bibliographies will be in one of the three official languages of the World Power Conference, *viz.*, English, French or German. The extracts will be indexed in accordance with the Universal Decimal Classification system, which makes it possible to amalgamate into a single index all contributions to the bibliography, irrespective of the source and language employed. The abstracts will be printed on one side of the paper only, and will be suitable for mounting.

The following Organisations are co-operating in the compilation of the Bibliography : Fuel Research Division, Department of Scientific and Industrial Research; British Chemical Plant Manufacturers' Association; British Electrical and Allied Manufacturers' Association; Institution of Petroleum Technologists; National Federation of Iron and Steel Manufacturers; National Gas Council of Great Britain and Ireland.

Directory of Paper Makers. 1931. Pp. 276. London : Marchant Singer and Co., 47, St. Mary Axe, E.C.3. Price 5s. 6d.

The 1931 issue of this highly important Directory is the 55th annual publication, a copy of which should prove very helpful and useful to all those connected with the paper trade.

It has been authentically revised and brought up-to-date as many changes have taken place since the publication of the 1930 edition.

It includes lists of mills, paper makers, agents ,enamellers, gummers, etc., in the Trade Designations section over a hundred additions have been made to Actual Watermarks and over five hundred and sixty to. Trade Names, besides transfers and numerous withdrawls.

Piestany Spa, Czechoslovakia. We have received an interesting booklet dealing with the baths and radioactive mud springs of Piestany in Czechoslovakia.

The Piestany 158° F. hot mud springs of volcanic origin supply the most effective medium for the treatment of " rheumatic " diseases, all the different kinds of arthritis, gout, sciatica, lumbago, neuralgias and kindred ailments. The greatest international medical authorities declare them unique and sufferers from 40 different nations from all parts of the world congre-

an account of the history and geography of the interesting country around this important curative spa and health resort. Further information can be obtained from Piestany Spa Representation, 38, Sackville Street, Piccadilly, W.1. The Agents for the Piestany Mud Products are McClure, Young asnd Co., Ltd., Eclipse Works, Glentham Road, S.W.13.

We have received the Fourth *Annual Report* of the Australian Council for Scientific and Industrial Research (for the year ending June, 1930). This Report gives a very full summary of all the investigations undertaken under the direction of the Council and covered wide fields in agricultural research in general. Of particular interest to chemists is the section dealing with the work done upon forestry products.

In a monograph entitled *Über die sterische Hinderung bei Reaktionen von Aminosäuren und Polypeptiden* (pp. 32. Gustav Fock, Leipzig) Dr. Vlassios Vlassopoulos describes the phenomena of steric hindrance and its bearing upon the reactions of the complex polypeptides, particularly as regards the introduction of amino-groups into amina-acids. He discusses Lapworth's theory and goes on to consider the effect of the phenomena in connection with higher alcohols and aromatic substances. Prof. Abderhalden has contributed a preface to the monograph.

The firm of Buchhandlung Gustav Frock, Leipzig, C.1, have also just issued a catalogue of the books, journals and monographs comprising the library of the late Prof. Otto Wallach, which they have arranged for sale. This very complete private library contains long series of German periodicals, organic text books and treatises and works dealing with other branches of chemistry of science.

OFFICIAL PUBLICATIONS RECEIVED.

U.S. Department of Commerce,
Bureau of Standards.

Filters for the Reproduction of Sunlight and Daylight and the Determination of Colour Temperature. By R. Davis and K. S. Gibson. Miscellaneous Publication, Bureau of Standards, No. 114. Price 45 cents.

Recommended Minimum Requirements for Fire Resistance in Buildings. Building and Housing No. 14. Price 10 cents.

Forthcoming Events.

MONDAY, MAY 11.

Iron and Steel Institute. Cleveland Technical Institute, Corporation Road, Middlesborough, at 7.30 p.m. "Production Economy in Iron and Steel Works," by O. Cromberg.

"Melting Shop of the Appleby Iron Company, Ltd," by A. Robinson.

TUESDAY, MAY 12.

Institution of Civil Engineers. Annual General Meeting. Great George Street, Westminster.

Institution of Petroleum Technologists. General Meeting. Royal Society of Arts, John Street, Adelphi, W.C., at 5.30 p.m.

WEDNESDAY, MAY 13.

Institute of Fuel. Burlington House. Piccadilly, W.1., at 6 p.m. "Continuous Production of Water-Gas from Powdered Fuel," by Dr. Ing. A. Thau.

Royal Society of Arts, John Street, Adelphi, W.C., at 8 p.m. Ordinary Meeting. "Architecture in Cronerete on the Pacific Ocean," by Major R. A. B. Smith, M.C., Member of the Council of the Portland Cement Association.

Electroplaters and Depositors Society. Northampton Polytechnic Institute, St. John Street, E.C.1., at 8.15 p.m. "Problems in Chromium Plating and High Current Density Nickel Plating," by N. R. Laban.

THURSDAY, MAY 14.

Oil and Colour Chemists' Association. Annual General Meeting. 30, Russell Square, W.C.1., at 7.30 p.m. "Properties of Synthetic Resins," by W. D. Owen and A. M. Thomas.

Institution of Electrical Engineers. Savoy Place, W.C.2. "Commeration of Centenary of Birth of David Edward Hughes," by S. Evershed. Followed by Annual General Meeting at 6.45 p.m.

Iron and Steel Institute. 95, New Street, Birmingham, at 7 p.m. "First Report on the Corrosion of Iron and Steel," being a report by the joint Committee of *the Iron and Steel Institute, and the* National Federation of Iron and Steel Manufacturers to the Iron and Steel Industrial Research Council. "Production gate in Piestany. The booklet also gives

Economy in Iron and Steel Works," by O. Cromberg. "*On the Nature Defective Lamintations in Wrought-Iron Bars and Chain Links*," by H. J. Gough, and A. J. Murphy.

"Melting Shop of the Appleby Iron Company Ltd.," by A. Robinson.

THE OPTICAL SOCIETY. Imperial College of Science and Technology, Imperial Institute Road, South Kensington, at 7.30 p.m. Annual General Meeting and Ordinary Meeting.

FRIDAY, MAY 15.

PHYSICAL SOCIETY. Imperial College of Science, S.W.7., at 5 p.m.

INSTITUTE OF CHEMISTRY. Belfast and District Section. Royal Belfast Academical Institution, at 7.30 p.m. Annual General Meeting.

ROYAL INSTITUTION, 21 Albermarle Street, W.1., at 9 p.m. "Experimental Aspects of Hydrogen Ion Concentration," by J. C. Phillip, O.B.E., D.Sc., F.R.S.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

10,855.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of condensation products. April 13.

11,014.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of therapeutically-aetive compounds. April 14.

11,052.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of hydroearboxylic acids of tetrahydronaphthocarbazoles. April 14.

11,295.—I. G. Farbenindustrie Akt.-Ges. Apparatus for carrying out catalytic reactions. April 16.

Specifications Published.

346,288.—Horsley, G. F., and Imperial Chemical Industries, Ltd.—Hydration of acetylene.

346,355.—British Celanese, Ltd., Kirk, E. W., Olpin, H. C., and Ellis, G. H. —Manufacture of anthraquinone derivatives.

346,404.—I. G. Farbenindustrie Akt.-Ges. —*Process for the manufacture of strontium oxide.*

346,470.—Imperial Chemical Industries, Ltd., Higgins, C. L., and Barker, J. T.—Producing chlorine and hydrogen.

Abstract Published.

340,585.—Destructive hydrogenation. I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany.

Carbazole is recovered from tar fractions containing carbazole by treating the initial material with hydrogen or gases supplying hydrogen, at temperatures above 300°C. but below 550°C., and under pressure, preferably in the presence of catalysts such as the metals of the sixth group of the periodic system ,or zinc, aluminium, silicon, manganese or their compounds. The temperature and pressure should be such that the carbazol itself is not decomposed. The carbazol may be obtained by cooling the product and filtering, or by distilling off the low boiling constituents. In an example, a mixture of anthracene residues and anthracene oil is treated with hydrogen under a pressure of 200 atmospheres at 440°C., in the presence of a catalyst containing molybdenum, chromium and manganese. The vapours leaving with the hydrogen are condensed and the carbazole filtered from the coll condensate.

CONFESSIONS OF GREAT SOULS.

By the REV. J. E. ROSCOE, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

The work is handsomely bound, and has a copious index for easy reference, and the work, containing as it does, the gems of thought on some of the world's greatest thinkers, will form an acquisition to any library.

By post, 5/- net.

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Surplus Books For Sale
At Bargain Prices.

A list of various Important Scientific Books for Sale at usually ***less than half published prices*** *will be sent on application to the Manager, Chemical News, Merton House, Salisbury Square, London, E.C.4.*

THE EFFECT OF NITRITES IN ACETIC ANHYDRYDE MEDIUM ON SOME BENZENE DERIVATIVES.

By GEORGE BACHARACH AND BENJAMIN PELTZ.

(Performed in the laboratory of Organic Chemistry of Fordham University, New York.)

Whenever nitrites are used for the purpose of nitrosation and in a limited way nitration of aromatic compounds, the nitrate is generally used together with a mineral acid. Although Gulinov[1] nitrosated salicylic acid in aqueous solution by the addition of glacial acetic acid, we consider this reaction as of the same type as the ones mentioned above. In view of the fact that many aromatic and even some aliphatic compounds may be nitrated with metallic nitrates in an acetic anhydride medium, where apparently the nitrate first seems to react with acetic anhydride[2/3] it seemed interesting to us to make a study of the nitrites in like conditions. We were limited in our work to such nitrites as were readily available and in dry enough state as to make the reaction seem probable, like $Pb(NO_2)_2$, $AgNO_2$, KNO_2, $NaNO_2$ and $Ba(NO_2)_2$. We studied the action of these substances on aniline, p-toluidine and phenol with the result that a reaction could only be observed in the case of $Ba(NO_2)_2$ on phenol, and not a nitrosation, but a nitration to p- nitro-phenol. None of the other nitrites reacted. Comparing these results with the ones obtained with the corresponding nitrates we find perfect harmony in their behaviour. The nitrates of Pb, Ag and the alkali nitrates (except $LiNO_3$) react not at all, while those of the earth-alkalis react at least mildly. The best reactions were obtained with the nitrates Cu, Hg, Fe, Co, and Mn, but unfortunately a study of the corresponding nitrites was impossible, they are either difficultly available or, like cupric nitrite, so hygroscopic that only a solution can be obtained. But the reaction we wanted to study calls for an anhydrous medium.

NITRATION OF PHENOL WITH BARIUM NITRATE IN ACETIC ANHYDRIDE MEDIUM.

To a mixture of 10 grms. of $Ba(NO_3)_2$ and 40 cc. of acetic anhydride and 20 cc. of glacial acetic acid was added 8 grms. of phenol. The mixture was heated for one hour under reflux. It became dark and a slight amount of NO_2 fumes were given off. After having allowed to cool, the mix-

ture was introduced into 250 cc. of ice-cold water. It was partially neutralised with sodium carbonate and submitted to steam distillation. A small amount of a yellow oil could be separated from the steam-distillate. It was dried by the addition of a few pieces of $CaCl_2$ and re-distilled. The second distillate was colourless and came over between 191-194° C. It was further distilled until a constant boiling point of 194° C. was reached. This is the boiling point of phenyl-acetate.

The identity of this substance was further ascertained by saponification with a sodium hydroxide solution, as a result of which it yielded phenol.

The residue remaining in the distilling flask was acidified with HCl, filtered and extracted with ether. Upon evaporation of the ether a brownish, crystalline substance remains which melts at 112-113° C. Further re-crystallisation from alcohol brought forth lighter crystals melting at 113° C. A mixed melting point determination with an equal quantity of known p-nitro phenol (M.P. 112°) gave 112.5° C. The substance, therefore, is p-nitro phenol.

SUMMARY.

1. A study of the nitrosation or nitration possibilities of aniline, p-toluidine and phenol with the nitrites of Pb, Ag, Na, and K in acetic anhydride-aceticacid medium gave negative results.

2. A partial nitration of phenol was effected with barium nitrite in acetic anhydride-acetic acid medium.

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[3] Bacharach, *J. Amer. Chem. Soc.*, 1927, XLIX, 1522.

BOARD OF TRADE OFFICES IN NEWCASTLE-ON-TYNE.

The Mercantile Marine Office, Board of Trade, hitherto accommodated at The Close, Newcastle-on-Tyne, has been removed to Telephone House, Carliol Square, Newcastle-on-Tyne. (Telephone number, Central 8371.)

THE ISOLATION OF ANONAINE FROM ANONA SQUAMOSA (LINNÆUS).

By FELICIANA R. REYES AND ALFREDO C. SANTOS.

(*Department of Pharmaceutical Chemistry, University of the Philippines, Manila.*)

Anona squamosa Linnæus, commonly known as " ates," is a plant cultivated throughout the Philippines. According to Tavera the powdered seeds are used to kill parasites of the human body, especially lice.

Very little is known of the chemistry of the plant. N. Trimourti obtained from the leaves a white powdery base in the amount of 0.4 per cent. calculated as chloroplatinate. It appears that Trimourti did not obtain the pure base.

In a recent communication, one of us reported the isolation of anonaine from the bark of *Anona reticulata* Linnæus, a base melting at 122 to 123°. Based on the result of the elementary analysis, molecular-weight determinations, and the analysis of the hydrochloride and the chloroplatinate the formula $C_{17}H_{18}NO_3$ has been adopted for anonaine.

To determine the possible relation between the base of Trimourti and anonaine, the bark of *Anona squamosa* has been chemically examined and found to contain a crystalline alkaloid melting at 122 to 123°. In this communication it is further shown that this base is identical with anonaine. The melting points of the free base from *Anona squamosa* and that of anonaine as well as their hydrochlorides and chloroplatinates agree with each other. No depression was observed when the melting points of the mixed free bases, and other salts mentioned, were determined as shown in the following table :—

	Anonaine from *Anona reticulata.*	Base from *Anona squamosa.*	Melting point of mixture.
	°C	°C	°C
Base...	122-23	122-23	122-23
Hydrochloride (decomposed)	287-88	287-88	287
Chloroplatinate (decomposed)	248.5	247	248.5

It would now be very interesting to examine *Anona muricata* Linnæus to find out the relation to anoniane of the amorphous alkaloid mentioned by Callan and Tutin.

EXPERIMENTAL.

For the isolation of the alkaloid the method used in the isolation of anonaine from *Anona reticulata* Linnæus has been followed. Alkaloid, weighing 0.258 gram, was obtained from 1.8 kilograms of material; yield, 0.0143 per cent.

After several recrystallisations of the hydrochloride the free base was prepared and found to melt at 122 to 123°. The mixed melting point with authentic anonaine was 122 to 123°.

In the previous communication the melting points of anonaine hydrochloride and anonaine chloroplatinate as obtained from *Anona reticulata* Linnæus were not reported. These constants have been determined and are 287 to 288° for anonaine hydrochloride and 248.5° for anonaine chloroplatinate. The melting points of the hydrochloride and of the chloroplatinate of the base under examination were 287 to 288° and 247°, respectively. Mixed melting point with authentic anonaine hydrochloride and anonaine chloroplatinate gave 287° and 248.5°, respectively.

—From *Philip. Journ. Sci.*

STEAM GENERATION EFFICIENCY.

A NEW INDUSTRIAL FURNACE EQUIPMENT.

(By a Well Known Engineer.)

For the operation of "Lancashire" and smaller water tube boilers, and industrial steam plant generally, the main object to mechanical stoking is well known to be the wear and tear and cost of upkeep of the moving bars and accessory equipment, as distinct from the coal feed gear which is not exposed to the heat. In this connection considerable interest attaches to an important design of boiler furnace that has now been placed on the market by the Turbine Furnace Company, Ltd., consisting of their forced draught grate with the addition of sprinkler stoker gear for the mechanical feeding of the coal, the first installation being now in operation on a "Lancashire" boiler at the Collyhurst Finishing Company, Collyhurst, Manchester.

The grate is also fitted at the back with a combined extension bridge and cleaning-out grate, and in this case is running with mechanical forced draught fan and trunking, taking only about 3 h.p. instead of steam jets, either system being equally suitable for giving a high temperature in the furnace and complete combustion with absence of smoke.

It is claimed that this combination of forced draught furnace and sprinkling stoker gear, with hand cleaning out of the ash and clinker, embodies most of the advantages of mechanical and hand firing, while at the same time eliminating the chief disadvantages mentioned, that is severe wear and tear, cost of maintenance, and breakdowns.

The coal feed gear operates at the uniform rate of ten charges sprinkler per minute, but it can be altered almost instantly so that the individual charge is varied from a few ounces to 2.0 lbs. and any solid fuel can be taken from dust up to pieces 2″ cube.

Hand cleaning is easily undertaken at fairly long intervals, using the extension piece at the back for taking part of the fire, especially since the design of the furnace tends to keep the ash granular and prevent the formation of clinker.

It may be remembered the standard "Turbine" furnace has a grate made up of large longitudinal hollow cast iron troughs, side by side, say five in number, for a standard 3′ 0″ wide grate. Also the surface of the grate is composed of a large number of very small and short transverse interlocking slotted firebare or "elements" fixed across the top of these troughs, giving an effective distribution of the air to the furnace. Thus for a standard 5′ 6″ × 3′ 0″ grate each trough has 45 small transverse bars with 9 air spaces, corresponding to 225 small bars and 2025 spaces. Further, these elements have below a sloping projecting portion, like the blade of a turbine, which dips in the blast current of air in the troughs below, given by a fan or steam jets, diverting the correct small volume of air corresponding to the particular aperture.

The mechanical coal feed with hopper for the coal is of standard sprinkler type for each furnace tube, with a shovel and powerful spring, which is released automatically at short intervals by means of a cam device, perking or throwing a small amount of the coal into the fire, while below is a fire door for the cleaning out. Also the air in the case of fan draught is admitted by vertical trunking in front of the boiler from the boiler honse floor which contains a deflector plate, while the furnace has at the back a cleaning door underneath, the whole constituting a neat and efficient arrangement.

THE INDUSTRY OF PHENOL-FORMALDEHYDE RESINS IN JAPAN.

In the recent issue of the report of the Municipal Industrial Laboratory of Osaka, Dr. Tadae Shono published his extensive researches on the condensation products of formaldehyde and phenol. It contains a short article concerning the development and the present status of the manufacture and applications of these substances, besides the results of his researches on the chemistry of the condensation which is the main part of the report.

According to Dr. Shono, first patents of the progress were granted to Dr. Baekeland in 1908 in Japan and the manufacture of the resins was started in 1915 according to Baekeland's patents by the Sankyo Company, which is to-day the largest producer. Several Japanese investigators tried, some succeeded in finding those simpler processes by which the transparent mass could be obtained without the use of high pressure. As these processes were easier, many factories were started one after another from about 1921, especially in Osaka district including Osaka City, most of them were very small ones. To-day, more than 60 per cent. of the total production is produced by these small factories, and the accurate statistical data of production, etc., are very difficult to get, but it is estimated that the annnal production of the phenol-formaldehyde resins amounts nearly 1,000,000 lbs., and the annual consumption of phenol and that of formalin for this purpose occupy a very large portion of their respective total consumption.

The products are sold in many various forms, which may be divided into 3 classes, namely, (1) the amber-like masses or the pure final condensation products which contain no or very little other materials (2) the varnishes or the products and their solution of the intermediate stages of condensation, and (3) the compound goods and compressed masses which are composed of the final condensation products and the various compound materials.

The amber-like masses are now the most important product in this country. The annual production amounted 668,700 lbs. (from August, 1926, to July, 1926, all statistical data below are of this period), of which 616,700 lbs. were produced by the small factories in Osaka district. These masses are mainly used to make the smoking pipes and the handles for umbrellas and parasols. For the smoking pipes, 654,000 lbs. were consumed and about 1,685,000 dozen smoking pipes were made, the price of which amounted about 1,685,000 yen. A quarter of these smoking pipes were exported from Osaka and Kobe. The other part, 14,700 lbs. are used to make handles.

For the production of the varnishes of phenol-formaldehyde resin, 315,000 lbs. of the resin were made annually, of which 270,000 lbs. by the Sankyo Company in Tokyo. Of these varnishes, a rather small portion, about 3 per cent., is used for the real varnish use, that is, to coat various bodies, but the main portion is used to make compound goods and compressed masses.

The compound goods are made by pressing the mixture of the varnish and suitable compound materials at high temperature. Various goods are made, for example, the parts for electric machines and equipments, bearing metal substitutes, ebonite goods substitutes, japanned goods subsititutes such as soup bowls, etc. For this purpose, 87 per cent of the total production of the varnishes was consumed. And their annual production is estimated to be 683,000 lbs. and their price 3,410,000 yen. The Sankyo Company is now the largest producer in this field.

The compressed masses are sold as plates of various thickness and made by pressing paper of cotton clothes impregnated with the varnish at high temperature. These masses are used as the parts of electric machines and equipments after suitable working. Their annual production is estimated to be 62,000 lbs. and their price 186,000 yen.

The Japanese patents concerning this industry up to the July of 1929 reached 97 in number. These are the present status of the industry of phenol-formaldehyde resins in Japan. The smoking pipe making is the most important now, but other more promising fields are left for the fnture.

CANADIAN SILICA.

The materials produced in the silica mining industry are: silica sand for the manufacture of glass, carborundum, and for use in steel foundries; silex, the finely pulverized silica sand which is important as a grinding and polishing substance; quartz and quartzite for smelter flux, ferrosilicon, and silica brick.

NOTES ON THE RECONSTRUCTION OF THE ROYAL INSTITUTION.

The desirability of rebuilding a considerable part of the Royal Institution, which had long been recognised became a necessity some two years ago after a series of alarming explosions in Albemarle Street which compelled the attention of the Managers to the very dangerous condition of the Lecture Theatre. This historic room the scene of the Friday Evening Discourses and experiments of Davy, of Faraday and of a long line of distinguished scientific men over a period of 130 years, had remained practically unaltered since it was completed, under the personal supervision of the founder of the Institution, Count Rumford, in 1802. It was built entirely of timber, and by modern standards was very ill-provided with exists. A survey, which was made by direction of the Managers two years ago, showed the fire risks to be so grave that they could no longer be ignored. Plans were prepared and after lengthy consideration a scheme of reconstruction was undertaken.

The principal consideration in the rebuilding has been to satisfy modern standards of security by means of fireproof construction and by the provision of suitable exits; but the perfection of the design of the Lecture Theatre for the scientific purpose for which it was built has been recognised the world over, and succeeding generations of Members have held their meeting room in affectionate regard, so that it has been a particular care to effect the restoration with as little modification of its qualities and appearance as possible. This desire has often been in conflict with the building requirements, and it is for those who now sit in the Lecture Theatre to judge how successfully the differences have been reconciled.

Advantage has naturally been taken of the opportunity to bring the equipment up-to-date, and the Theatre has been provided with a cinematograph projector, an epidiascope, a great variety of services to the lecture table for experimental purposes and a number of other refinements for the assistance of the lecturer and the convenience of his audience.

The rebuilding of the Lecture Theatre has involved the replanning and reconstruction of a large adjacent part of the building. On the first floor the Ante-room has been enlarged. Opening from it the north side is the Ambulatory around which, beneath the seating of the Theatre, show cases have been arranged for the display of the historic apparatus. From the south side of the Ante-room the new Long Corridor passes to the Far Library and provides access to the Davy Faraday Research Laboratory. Opening from the Long Corridor is a new Lecture Laboratory in which are prepared the experiments for the Lecture Table.

On the ground floor the arrangements have been largely determined by the requirements for exit to the street from the Theatre above. A new Entrance Hall has been constructed, some of the rooms have been replanned, and a large new Chemical Laboratory has been built. The basement area has been re-arranged, and contains the Workshops, the equipment for the distribution of electric power throughout the building and the heating and ventilating plant. The Institution is now provided with a heating system which is entirely electric.

The reconstruction has been carried out by the Architect to the Royal Institution, Mr. L. Rome Guthrie, F.R.I.B.A., of Messrs. Wimperis, Simpson and Guthrie, 61, South Molton Street, W.1; and Messrs. McLellan and Partners, 32, Victoria Street, S.W.1, have acted as Consulting Electrical Engineers.

The decorative work in the Ante-room, Long Corridor, New Entrance Hall and other reconstructed parts is in keeping with that of the older rooms. The key to the decoration is the beautiful Old Entrance Hall and Staircase, which existed in 1799 when the House was purchased on the foundation of the Institution, and has remained practically unaltered. It will be seen, in the Ante-room and elsewhere, that Mr. Guthrie in his new work has added distinction to the character and charm of the old, and has greatly enhanced the dignity and beauty of the Institution.

The steps which have been taken by the Managers to provide funds for the alterations have been referred to in the Annual Reports of the Visitors elsewhere; but it should be mentioned here that the Institution is indebted to many generous friends for gifts towards the decoration, furnishing and equipment of the House.

SPAIN'S FOREIGN TRADE IN 1930.

According to official valuations the debit trade balance has decreased enormously since 1928, the respective figures being 147·5 million gold pesetas for last year, 628·7 millions for 1929 and 886 millions for 1928. These returns are based on official valuations and not on the lower values as shown by the declaration of importers and exporters. Nevertheless, credence can still be given to the basic fact of decreases in the debit trade balance.

The relative improvement in the balance of trade has been due principally to a slight decrease in imports of foodstuffs, and an increase in exports of manufactured articles and foodstuffs.

Imports of aniline dyes and tanning and dyeing materials rose in value by about 25 million pesetas over the previous year. This was undoubtedly due to the termination of the activities of the Import Licensing Commission. Since this Commission has been dissolved, European suppliers of aniline dyes and tanning and dyeing materials have taken the opportunity to send comparatively large consignments of these products to Spain. Whether this movement will prove to be profitable it is difficult to say because since a good part of these stocks were sent in to Spain the foreign value of the peseta has declined still further.

Imports of cotton in bulk, *i.e.*, raw and waste cotton, show an increase in 1930 of 39 million pesetas over the previous year. This had more than its counterweight in the increase of 56 million pesetas in exports of manufactured cotton goods.

A decrease in imports of cement took place, as was to be expected in view of the cessation in the extremely active building programmes which went on up the end of 1929. The slight decrease in imports of coal and the smaller imports of timber were only significant as reflecting the general slackness of trade and industry.

A decline of about 36 million gold pesetas is shown for 1930 in imports of motor cars, etc. Whether the increase in the Customs Duties made last July, which was intended primarily to bring about this end, has been more effective than the depreciation of the peseta, it is perhaps difficult to say, but there is no doubt that imports of motor cars would in any case have decreased conciderably, owing to the depreciation of the peseta and the consequent general slackening of trade in Spain, together with the reduced purchasing power of the community.

Imports of iron manufactures and machinery fell off considerably, and those of cereals dropped enormously from the 1929 level.

The export trade in Spanish manufactured articles was given an extraordinary stimulus by the depreciation in the peseta. In so far as regards the increases in tanned hides and manufactures of this class, it is almost certain that the greater facility for the import of tanning and dyeing materials helped on this trade in addition. The large increase in the export of cotton goods over the previous year has already been noted. The decrease in exports of cork and cork products had nothing to do with the Spanish situation; it was a reflex of the economic situation in the United States.

The increase in exports of foodstuffs was very great indeed. Exports of olive oil increased tremendously and those of fresh fruit, rice and preserves, were also stimulated. The swollen exports of olive oil took place regardless of the fact that the olive crop in 1930 was very much below normal.

Participation in the 5th general meeting of the Dechema, German society for chemical apparatus is open to members of the Dechema and of the Verein deutscher Chemiker (German Chemists' Society). Special non-members tickets are not issued by the Dechema. The meeting takes place in Vienna from the 28th to the 30th May, 1931, and includes a symposium on the important subject "The separation of liquids and solids." Those intending to take part in the 44th general meeting of the Verein deutscher Chemiker should communicate with: Osterreichisches Verkehrsbüo, Wien 1, Friedrichstr. 7, Austria.

ARTIFICIAL SILK PRODUCTION IN CANADA.

One plant in Ontario makes rayon by the viscose process from bleached sulphite pulp produced at Kipawa, Quebec. A plant in Quebec makes celanese by the cellulose acetate process from cotton linters. The Kipawa mill is producing approximately half the world's supply of pulp for rayon.

GENERAL NOTES

THE POLISH CHEMICAL INDUSTRY.

The Polish Chemical Industry, being largely dependent on other industries, has suffered from the prevailing world wide depression and the growing difficulties which are being encountered in foreign markets on account of the low world price level of chemicals.

Production was reduced on the average by from 25 to 30 per cent. as compared with 1929, with the exception of artifiical fertilisers in which article, owing to the crises in agriculture ,the drop amounted to 40 per cent., the production of artificial silk was maintained on the level of 1929. Parallel with the fall in production there was in most articles a serious decline in consnmption ,as shown by the figures given below in respect of some articles :—

A. PRODUCTION.

...	1930	1929
	(In thousands of tons)	
Superphosphates	297	370
Caustic Soda	90	100
Sulphuric acid manufactured from zinc blende	250	300
Calcium Cyanamide	79	163
Artificial silk	2,700*	2,730*

*In tons.

B. CONSUMPTION.

Superphosphates	187	304
Caustic Soda	57	62
Calcium cyanamide	81	137

This industry was affected not only by the above causes but also by the fall in prices ,which in some cases was considerable as will be seen from the following statement :—

	Per cent.
Glue	18
Glycerine	10-15
Hydrochloric acid	19
Superphosphates	11
Calcium cyanamide	12
Artificial silk	15
Soap	12
Edible fats	13

Capital investments in existing works were reduced to a minimum and no new undertakings were started during the course of the year.

Keen Russian competition was felt in glue and caustic soda, and it reported that the Soviet Ultramarine is likely to appear shortly on the Polish market.

CANADIAN CHEMICAL INDUSTRIES.

INCREASED PRODUCTION OF ACIDS, ALKALIES AND SALTS IN 1929.

The rapid expansion of the mining and metallurgical industries in Canada in recent years has given rise in its turn to an increased production of sulphuric acid, the manufacture of which has been embarked npon partly in order to discover a means of obviating the destruction cansed by the emission of smelter fumes. The latest available figures in regard to the production of acids, alkalies and salts in Canada are, however, those just completed for the year 1929 by the Dominion Bureau of Statistics at Ottawa. In the year the total value of such products made for sale was $28,021,972, as compared with $21,256,286 in 1928. Fifteen plants were in operation in 1929, and of these 8 were in Ontario, 3 in British Columbia, 3 in Quebec and 1 in Nova Scotia. The industry had a total capital investment of $49,417,431, employees numbered 2,897; payments for salaries and wages totalled $4,338,686, and materials used in manufacturing cost $6,301,121.

Excepting sulphuric acid, output of which amounted to 110,749 tons of 66° Be acid worth $1,375,599, each of the commodities made in this industry was produced in only 1 or 2 plants and therefore separate production figures cannot be given. Sulphuric acid was made in 7 plants, nitric acid in 2, hydrochloric acid in 2, acetic acid in 2, sodium bisulphate in 2, while each of the following commodities was made by only 1 concern; calcium cyanamide, sodium sulphate, sodium carbonate, sodium cyanide, sodium hydroxide, ammonium phosphate, sodium hypochlorite, calcium carbide, liquid chlorine, acetylene black, hydrofluosilicic acid, butyl acetate, ethyl acetate, paraldehyde, acetaldehyde, phosphorus, and phosphoric acid.

PLANTING DOUGLAS FIR.

During the year ending September 30, 1929, the Forestry Commission of Great Britain planted 3,247,000 Douglas fir trees. The seed from which these were grown was obtained from the Forest Service of the Department of the Interior, and was extracted at the Service's seed-extracting plant at New Westminster, B.C.

THE PROPOSED AUSTRO-GERMAN CUSTOMS UNION AND THE EUROPEAN ECONOMIC SITUATION.

The announcement by the Governments of Austria and Germany, on March 21, of a scheme for a customs union between the two countries attracted widespread attention but it is doubtful whether the full significance of its economic and industrial effects has been appreciated. The matter is still *sub judice* in the sense that the question will be submitted to the League of Nations at Geneva and the future of the project depends largely upon its reception by the League.

It was subjected to a thorough analysis by Dr. E. Benes, the Czechoslovak Foreign Minister in a speech in the Prague Parliament on April 23, and his speech has been reprinted in English by "Orbis," price 1s.* Dr. Benes criticises the proposed customs union from the political and economic standpoints. After referring to the political effects such a union would have upon the other European nations the Czechoslovak Foreign Minister goes on to show its probable effects upon industry and commerce.

The present industrial crisis could probably hest he solved on a basis of universal free trade but it is extremely doubtful if the proposed tariff union between Germany (which has the highest agricultural protection in Europe) and Austria is a step in this direction. Already several important Austrian industrialists have expressed the opinion that such a union would adversely effect Austria's major industries. Dr. Benes has voiced the opinion of the industries of Central and Eastern Europe in his criticism of the scheme which would accentuate the agricultural crisis. It is difficult to see whom the proposed union would benefit, for it could not but adversely affect the trade of the two countries with their neighbours. There is no doubt that the high protectionist policies of most countries after the war have seriously hampered trade and economic recovery and Dr. Benes points out that a permanent improvement could be effected by a progressive process of stabilisation of industrial duties, a gradual reduction of customs duties, and a compromise on the taxes on main products.

This, it may be confidently hoped, would lead to the ultimate abolition of tariffs so that the avowed object of the Austro-German proposal could be attained by an entirely different method than proposed by the German and Austrian Governments.

*(Czechoslovak Sources and Documents No 6. Dr. E. Benes: *The Austro-German Customs Project*. Pp. 84 Orbis, Prague. 1931. 1s.)

PHENOL TO BE MANUFACTURED AT TORONTO.

The Dominion Tar and Chemical Company, Ltd., of Montreal, is erecting a plant for the manufacture of phenol and allied tar products. The new plant costing £50,000 will adjoin the existing plant of the Company at Toronto .

Phenol, largely nsed in the manufacture of resins which form the base of bakelite, is not being commercially manufactured in Canada at present.

The use of bakelite as an electrical insulator and for many other purposes is constantly increasing in Canadian industry; use is also made of phenol in many other industries including silk manufacturing, oil refining and the flotation processes of the mining industry.

The opening of the new plant will mark an important step in the progress of industrial chemistry in Canada. In addition to phenol the plant will manufacture ortho cresol, meta-para cresol, cresylic acid and various high boiling acids. These chemical derivatives will form another effective outlet for the tar production of the Company, which has greatly extended its operations in recent years. Through its subsidiaries the Company has thirteen creosoting plants in various parts of Canada at which railway ties, wood paving block and other commercial timbers are creosoted.

During the past year the Company spent over £165,000 on additions and improvements to existing plants and two new creosoting plants were erected at New Westminster, B.C., and Swift Current, Sask. A subsidiary of the Company, namely Fibre Conduits (Canada), Ltd., is manufacturing under-floor electrical products and the processing and marketing of roof products is carried on by two other subsidiaries—Alexander Murray and Co. and Canada Roof Products.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, April 30.

Papers read in title only :—

The Colorimetric Properties of the Spectrum. By J. Guild. Communicated by Sir Joseph Petavel, F.R.S.

The paper describes an investigation carried out at the National Physical Laboratory to determine the colormetric properties of a group of seven subjects as obtained from direct measurements of the trichromatic coefficients of the spectrum on a trichromatic colorimeter. The " spectral distribution curves of the primaries," by means of which the colorimetric quality of a heterochromatic stimulus may be computed from its energy distribution curve, are obtained by combining the experimentally determined trichromatic coefficients with the International Standard visibility curve. This procedure is a simplification, applicable to the mean results of a normal group, of a general method by which both the chromatic and luminosity functions of any subject or group of subjects can be determined from one set of observations. The general method is described in an Appendix.

The results of the investigation are compared with those obtained by other workers, and a proposal is made for the adoption of a set of standard data, to represeut a normal eye for technical colorimetric purposes, based on the results of this investigation and those recently published by W. D. Wright. A complete set of data, worked out on this basis, is included in the paper.

The Colloid Chemistry of Dyes. The Aqueous Solutions of Benzopurpurine 4B and its Isomer prepared from m-Tolidine. Parts I and II. By C. Robinson and H. A. T. Mills. Communicated by F. G. Donnan, F.R.S.

Although benzopurpurine 4B is a well-known cotton substantive dye, its isomer prepared from *m*-tolidine has not sufficient affinity for cotton for it to be of practical use as a dyestuff.

An investigation of the solutions of these dyestuffs has been carried out in order to see if correspondingly great differences could be found in their colloidal properties.

A method has been devised for the purification of these and similar dyestuffs. It has been shown that " ageing " phenomena do not take place in either of these solutions when pure.

The viscosity of the solutions of these dyes (if not super-heated) are the same and are of the order to be expected in an unhydrated colloid. The viscosity does not vary with rate of shear.

The conductivity of the dye solutions are of the same order.

On the other hand, ultra-filtration, flocculation by electrolytes, and ultra-microscopic examination, show marked differences between the two dyes, which may be explained if it is assumed that benzopurpurine 4B forms larger aggregates than the meta isomer.

The investigation of the solutions of benzopurpurine 4B and its isomer prepared from *m*-tolidine has been continued.

Osmotic pressure measurements have been carried out, the errors arising from membrane equilibria being reduced to a minimum amount of alkali necessary to prevent membrane hydrolysis can be calculated.

The osmotic pressures of tbe two dyes are almost the same. It has been shown that this can be accounted for in spite of the difference in particle size shown by the experiments described in Part I.

In the case of the dye prepared from " meta " tolidine, the size of the micelle has been calculated from the fall in the observed osmotic pressure when a concentration of sodium chloride, large compared with the concentration of these anions, but not large enough to bring about coagulation, is present.

We conclude from the results described in Parts I and II that both these dyes exist in solution as totally dissociated colloidal electrolytes, hydrolysis being negligible. The anion of each dye is an unhydrated, or only slightly hydrated, multiple anion, that of the " meta " dye consisting of about 10 elementary anions, while that of the " 4B " is considerably larger. The larger anion allows the benzopurine 4B to exhibit properties generally associated with colloids, while the small anion of the meta isomer gives it properties which might be mistaken for those of a true solution.

X-Ray Nondiagram Lines. By G. B. Deodhar. Communicated by O. W. Richardson, F.R.S.

The Chemical Constant of Chlorine Vapour and the Entropy of Crystalline Chlorine. By T. E. Stern. Communicated by R. H. Fowler, F.R.S.

Chlorine is considered to consist of three gases, namely $Cl_{35}Cl_{35}$, $Cl_{35}Cl_{37}$, and $Cl_{37}Cl_{37}$. The first and last sort art further supposed to consist of para- and ortho-varieties which remain distinct at sufficiently low temperatures.

By statistical mechanics the molecular composition of chlorine gas calculated, assuming that the ratio between the numbers of atoms of the two isotopes 35 and 37 is known. It is found in this calculation that the angular momenta of nuclei are without effect upon the constitution of chlorine gas.

By statistical mechanics the vapour pressure of chlorine crystals is calculated—making use of the writer's previous solution of a quantum mechanical problem representing approximately the "rotational" motion of molecules in crystals. By supposing that chlorine molecules do not rotate in chlorine crystals, a result is obtained for the chemical constant in good agreement with the experiments of Eucken.

Finally, the entropy of chlorine per mole in the crystalline form at the absolute zero is calculated.

The Molecular Symmetry of Hexa-amino-benzene in the Crystalline State and certain other Properties of the Substance. By I. E. Knaggs. Communicated by Sir William Bragg, F.R.S.

An examination of crystals of Hexa-aminobenzene by the powder X-ray photographic method has shown the crystal symmetry to be that of the holohedral cubic class, the space-group being O_h^3. There are 16 molecules in the unit cell of side 15·14 A.U., and the molecules possess a threefold axis of symmetry. A possible structure has been outlined.

The crystals have been examined also at liquid air temperature, and the coefficient of linear expansion between—183° C. and + 15° C. has been calculated from the change in the spacings of the reflecting planes which, in accordance with the cubic symmetry was found to be uniform for all planes.

The stability of the substance in air was studied by taking X-ray photographs after various intervals of time. In agreement with the views of Flürscheim and Holmes the stability was found to he greater than has generally been supposed.

The Effect of Foreign Gases on the Lower Critical Oxidation Limit of Phosphorus Vapour. By H. W. Melville and E. B. Ludlam. Communicated by J. Kendall, F.R.S.

The effect of different gases and vapours on the lower critical oxidation limit of phosphorus vapour has been investigated in order to test the equation originally proposed by Semenoff.

Evidence from the variation of the slopes of the curves with temperature confirms the opinion that the variation of the *diffusion coefficient* is the predominating causes of the differences obtained.

The Life on a Flat Plate Between Parallel Walls. By L. Rosenhead. Communicated by L. Prandtl, For.Mem.R.S.

A complete solution is obtained of the problem of the lift on a flat plate of infinite span between plane parallel walls. It is shown that the effect of the walls is to increase the lift-coefficieut, and curves and tables are given showing this increase for various values of the angle of attack and the ratio of chord of aerofoil to width of channel. To a first approximation the results agree with those obtained by Glauert's approximate theory.

It is also shown that the solution of the problem of a plate in the neighbourhood of a single plane wall can be obtained from the general result by a suitable limiting process.

The Behaviour of Electrolytes in Mixed Solvents. III. By J. A. V. Butler and A. D. Lees. Communicated by J. Kendall, F.R.S.

The molecular refractivities and partial molar volumes of lithium chloride have been determined in a series of mixed water-alcohol solvents. It is found that the molecular refractivity is constant in each solvent over the range of concentrations investigated. Its value is hardly affected by the presence of alcohol until the molar fraction of the latter is over 20 per cent., and then falls off steadily to the value for pure alcohol. On certain assumptions the proportions of water and alcohol molecules in contact with the ions are calculated, and it is found that the proportion of water molecules so situated is always greater than that in the solvent as a whole.

The effect of lithium chloride on the density of the solutions varies greatly with the composition of the solvent. The partial molar volume of the salt is much smaller in 100 per cent. alcohol than in water, but increases rapidly with the concentration. Its variation with the composition of the solvent, at a constant salt concentration, is similar to that of the refractivity.

The Exchange of Energy between Organic Molecules in a Molecular Beam and Metallic Surfaces. By F. O. Rice and H. T. Byck.

Communicated by F. G. Donnan, F.R.S.

An X-Ray Study of Mannitol, Dulcitol and Mannose. By T. C. Marwick. Communicated by Sir William Bragg, F.R.S.

A study of the X-ray data suggests that in all three cases the long dimension of the molecule corresponds to the *a*-axis. in the alcohols, the molecules appear to have the long-chain configuration; in the sugar, that of the manno-pyranose ring, with the longest dimension in the direction of the *a*-axis.

The relationship is traced between the structures of mannitol and dulcitol, and between the structures of mannose and other saccharides.

An account is given of a measurement of the area of cross section of the alcohol end-group, CH_2OH.

The Electrical Condition of Hot Surfaces during the Adsorption of Gases. By G. I. Finch and J. C. Stimpson. Communicated by W. A. Bone, F.R.S.

The electrical conditions of a carbon rod and a copper sheet have been studied at temperatures up to 850° C. *in vacuo*, and in contact with various gases. The results of these experiments suggest that "normalisation" of the carbon involves the evolution of occluded gases accompanied by structural changes in the surface, but that in the case of copper it involves a process of sintering. The copper sheet is completely blanketed by a film of copper oxide, with the result that it does not charge up either *in vacuo* or in contact with the oxygen. As the "normalisation" temperature of a surface is increased the surface potentials at a given temperature tend to approach towards zero. At 850° C. the values of the surface potentials on all the metal surfaces fall into three distinct groups. There is evidence that with increasing temperature the values of the surface potentials depend almost entirely on the nature of the gas with which they are in contact, aud are independent of the nature of the surface.

Investigations in the Infra-Red Region of the Spectrum. III and IV. By A. B. D. Cassie and C. R. Bailey. Communicated by F. G. Donnan, F.R.S.

The absorption spectrum of carbon di sulphide is described between the limits of 1 and 22 μ, and the results compared with those of Coblentz for the liquid. The molecule is shown to possess a rectilinear structure, with probably a single linkage between the carbon and sulphur atoms. The Raman spectrum has been co-ordinated with the infra-red spectrum, and an explanation is offered for the appearance in both of the characteristic doublet associated with the inactive frequency.

A monochromator method in the infra-red is described. which not only allows the maximum of resolution to be achieved with the prism spectrometer, but which promises to be of particular advantage in the examination of photo-sensitive substances.

Asymmetry Observed in the Stark Component of $H\alpha$. By D. R. McRae. Communicated by A. S. Eve, F.R.S.

1. A special grating having a very intense first-order spectrum on one side has been used to resolve the Stark components of $H\alpha$.

2. Asymmetry is observed in the displacements of the components.

3. This asymmetry is found to be, in general, qualitative agreement with the calculations of Schlapp. There are certain discrepancies, however, which have not been explained.

4. An asymmetry in the relative inteusities of the components has been observed. It is shown that altering the number of atoms in the initial states does not explain completely this asymmetry.

5. Under the conditions of this experiment, the intensities of the components become symmetrical if the discharge is through helium, neon, or xenon, in which traces of hydrogen exist.

The Apparent Hemihedrism of Crystals of Lead Chloride and Some Other Salts. By F. D. Miles. Communicated by Sir William Bragg, F.R.S.

It is well known that etch-figures on the faces of a crystal may point to a symmetry lower than that usually ascribed to the crystal. The subject is reviewed and the probably dependence of the phenomenon on the asymmetric molecular configuration of the etching agent is discussed.

Lead chloride, which normally shows holohedral orthorhombic symmetry can, under certain specified conditions, be obtained from hot solutions containing dextrine in microscopic crystals consisting of a single form, a bisphenoid), which can have only axial symmetry. By reducing the concentration of dextrine this form can be gradually repressed. Lead bromide and mercuric bromide provide subsidiary examples of the same phenomenon; the modifications produced in three separate cases differ less widely from the normal than

before, but are all incompatible with the accepted holohedry.

Normal crystals of lead chloride were grown and investigated by ½-ray methods. The results are given. The difficulty of X-ray work with crystals impervious to the radiation is emphasised, and a simple method is given for finding whether any given reflection will emerge from any crystal face. It was established that the structure contains two glide planes of symmetry. The symmetry is, therefore, in all probability holohedral. The idea that crystal faces lying opposite to each other across a plane of symetry may behave differently to an optically-active reagent is supported. The cases described appear to be the first to demonstrate that the presence of optically-active material may induce the growth of a hemihedral crystal of a substance. the normal symmetry of which is certainly higher.

The Use of Thyratrons for High Speed Automatic Counting of Physical Phenomena. By C. E. Wynn-Williams. Communicated by Lord Rutherford, F.R.S.

The thyratron may be regarded as a triode valve which contains a trace of mercury vapour or inert gas at low pressure. Under appropriate conditions, a positive voltage impulse of only a few micro-seconds' duration applied to the grid will cause an arc to strike between the anode and cathode (or filament). The arc then continues independently of further grid potential changes until the anode circuit is momentarily interrupted. In this respect the thyratron behaves as a very delicate, inertialess relay, capable of controlling considerable currents.

THE GEOLOGICAL SOCIETY.

APRIL 22.

Prof. E. J. Garwood, M.A., Sc.D., F.R.S., President, in the Chair.

Communications read :—

Xenoliths of Igneous Origin in the Trégastel-Ploumanac'h Granite, Côtes-du-Nord, France. By Herbert Henry Thomas, M.A., Sc.D., F.R.S., V.P.G.S., and Walter Campbell Smith, M.C., T.D., M.A., Sec.G.S.

In the neighbourhood of Trégastel, about 7 miles north of Lannion, a red porphyritic biotite-granite crops out along the coast and forms the rising ground for several miles inland. In parts, this granite is remarkable for the abundance xenoliths which it contains. Some of these are of sedimentary origin, but the majority are of the kind usually referred to as "basic segregations." A patch of basic rock covering an area of about a mile and a half from north to south and about half a mile wide is entirely surrounded by granite. Its most basic portions are of biotite-bearing olivine-norite. Impregnation by, and reaction with, the invading granite has given rise to a whole series of hybrid rocks varying through hypersthene-gabbro, augitic quartz-biotite-diorite, to quartz-biotite-diorite, and even to a biotite-rich granitic stage. Near the junction of the granite with the hybrid rocks, "basic segregations" are very numerous. When examined, they prove to have a structure and mineral composition corresponding to the various stages presented by the basic hybrids, and on the extreme margin of the hybrid rock the xenoliths may be seen in the process of separation from the parent mass. The occasional presence of large felspars in the xenoliths is discussed, and the Authors are of opinion that these are xenocrysts and have not grown in place. Evidence is produced to show that the basic mass from which the xenoliths were derived was most probably part of the roof of the granite.

Comparisons are made with rocks from other areas.

The Loch Doon "Granite" Area, Galloway. By Charles Irving Gardiner, M.A., F.G.S., and Prof. Sidney Hugh Reynolds, M.A., Sc.D., F.G.S.

The Loch Doon "granite" mass has a length of 11½ and a maximum width of 6½ miles and covers an area of about 47 square miles. The plutonic rocks are almost everywhere surrounded by high hills composed of metamorphosed Ordovician sediments.

The plutonic rocks are of three main types :—

1. The prevalent rock, intermediate in character, is a quartz-mica-diorite or tonalite with an average specific gravity of 2.71.
2. The central ridge is formed of biotite-granite with an average specific gravity of 2.63.
3. At the southern and north-western ends of the plutonic mass the rock is a norite with an average specific gravity of 2.81. A third mass of norite, probably analogous to the other two, is found in the isolated exposure of Burnhead, about 1½ miles east of the plutonic boundary.

Analyses were prepared by Mr. E. G. Radley. The most interesting problem concerning the plutonic mass is to determine the mutual relations of the rocks and to ascertain whether their different varieties may be considered to have arisen by differentiation subsequent to intrusion, or whether the facts point to each of the three rock-types being a separate intrusion.

Except for the Arenig cherty series, the sediments surrounding the Loch Doon plutonic mass form a somewhat monotonous series of grits and flags with no calcareous rocks. Biotite-cordierite-hornfels is the prevalent rock-type formed by the metamorphism. The highest grade of metamorphism is found in the xenoliths enclosed in the tonalite; these occasionally contain corundum.

The Arenig cherts become recrystallized as quartzites with biotite, pyroxene, garnet, and occasionally schorl in the interstices between the quartz grains.

MAY 6.

The Geology of the Country around Mynydd Rhiw and Sarn, South-Western Lleyn (Carnarvonshire). By CHARLES ALFRED MATLEY, D.Sc., F.G.S.

The region described contains about 9 square miles of the Palæozoic country of South-Western Lleyn. It is situated between Porth Neigwl on the east and the Pre-Cambrian rocks of the Mona Complex on the west, and includes a ridge of high ground which stretches from Mynydd Penarfynydd in the south to Mynydd Cefnamwlch in the north ,and attains a height of 994 feet on Mynydd Rhiw. Much of the lower ground is covered by glacial drift.

The sedimentary rocks are of Arenig and lower Llanvirn age, and range from the Extensus Zone to a high part of the Bifidus Zone. The local base of the Arenig is found at only one small exposure, and there it rests on the mica-schists (Penmynydd Zone) of the Mona Complex.

Intrusive rocks are abundant, and range in composition from acidic to ultra-basic; they are linked genetically by their common richness in soda, aud can be considered, with the volcanic rocks, as varied members of one spilitic suite. They include the Sarn Granite, numerous albite-dolerite sills, and the coarser-grained intrusions of picrite, proterobase, and hornblende-dolerite which are found only at the top of the sequence. These intrusions are discussed, and the possibility considered that they may be a single sill or laccolith broken and displaced by faulting. All the igneous rocks, extrusive and intrusive ,thin out northwards.

A few albite-dolerite dykes of Palæozoic age have been found, two of which intrude into the Sarn Granite. A perlitic soda-rhyolite dyke, found near the Sarn Granite, seems to be an offshoot from it.

A correlation is made of the vulcanicity of this area with that in other parts of Wales and Shropshire. The paper also contains some remarks on the tectonics.

An Ordovician Grit from Anglesey, with its bearings up Palæogeography, and upon the Tectonics of the Mona Complex. By EDWARD GREENLY, D.Sc., F.G.S., and PROF. PERCY GEORGE HAMNALL BOSWELL, D.Sc., F.G.S.

The grits at the base of the Arenig beds are Berwfi near Holland Arms, have been found to be exceptionally rich in heavy minerals. Garnet, sphene, and epidote are wonderfully abundant, as are ilmenite, biotite, and white-mica. The felspars are orthoclase, albite, and oligoclase. Tourmaline and glaucophane are absent, and only one grain of green hornblende has been seen. There are also small pebbles of Penmynydd Zone mica-schist, Gwna Green schist, and many of grantoid acid gneiss.

The source cannot be far distant, for the deposits are poorly graded, and the grains angular or even splintery. A source near at hand, however, can be only the Mona Complex.

The absence of tourmaline excludes at once the middle region, so the orthoclase must be traced to the augen of the Penmynydd Zone. The albite, oligoclase, garnet, sphene, ilmenite, and other minerals can only have come from the gneisses. The absence of amphiboles excludes both the basic gneisses and the basic members of the Penmynydd Zone, in spite of the proximity of those rocks to Berw. Accordingly, the evidence both of minerals and rock-fragments point to the acid gneisses as the principal source, with contributions from the Gwna Beds and the acid members of the Penmynydd Zone.

The basic members of the Penmynydd Zone would have been, in Ordovican time, covered by Gwna Beds; not so the basic gneisses, for they are not affected by the Gwna metamorphism. Although large masses of acid gneiss, now invisible, have been invoked, they cannot lie buried under the coalfield, for the slopes of the sub-Ordovician land all converged towards the Trewan Cirque, and the slope at Berw

must, therefore, have been westward. This acid gneiss must have lain higher up, and have been destroyed by waste. In that case it would provide the needed shield for the basic gneiss.

Finally, this furnishes unexpected confirmation of a tentative hypothesis, already put forward, that the gneiss of Holland Arms, instead of having been brought up from below, has been brougrt down from above, an an infold of the Newborough Slide, from the inverted upper limb of the Bodorgan recumbent fold.

ROYAL INSTITUTION.

The Annual Meeting of the Members of the Royal Institution was held on May 1, Sir Robert Robertson, Treasurer and Vice President, in the Chair. The Annual Report of the Committee of Visitors for the year 1930, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. The Report of the Davy Faraday Research Laboratory Committee was also read. Thirty-six new Members were elected during the year. Thanks were voted to the President ,Treasurer and Secretary, to the Committees of Managers and Visitors, and to the Professors, for their valuable services to the Institution during the past year. The following gentlemen were unanimously elected as Officers for the ensuing year: President : The Right Hon. Lord Eustace Percy. Treasurer : Sir Robert Robertson. Secretary : Major C. E. I. Phillips. Managers : Sir John Cadman, A. Chaston Chapman, Sir James Crichton-Browne, Right Hon. The Viscount Falmouth, Sir Robert Hadfield, J. S. Highfield, Sir Herbert Jackson, Sir Lawrence Jones, Sir Arthur Keith, Sir Henry Lyons, Charles M. Merz, Sir Henry Miers, Robert Mond, R. W. Paul and H. M. Ross. Visitors : Colonel N. T. Belaiew, J. J. Fox, K. R. Hay, Emile S. Mond, Percy J. Neate, A. O. Rankine, Edwin H. Rayner, Russell J. Reynolds, W. S. Rowntree, T. C. Sandeman, Major W. S. Tucker, Frank Twyman, Robert S. Whipple and H. E. Wimperis.

ROYAL INSTITUTION.

A General Meeting of the Members of the Royal Institution was held on Monday May 4, Sir Robert Robertson, Treasure and Vice-President, in the Chair. Sir Joseph Thomson was re-elected Honorary Professor of Natural Philosophy, and Lord Rutherford of Nelson was re-elected Professor of Natural Philosophy.

NOTICES OF BOOKS.

Bratislava (Pressburg) in Wort und Bild. By CHARLES BENYOVSZKY. Pp. 192 with 32 illustrations and 2 maps. Bratislava : S. Steiner's. 1931. Price 18 Czech crowns (2s. 3d.)

Bratislava on the Danube, is the capital of Slovakia, the eastern half of the Czechoslovak republic. It is a city with 130,000 inhabitants and its industries include the manufacture of sulphuric acid and other heavy chemicals and explosives. The refining of petroleum, electrotechnical and cable works, and metal, wood and textile trades are among its other industries. The annual Danube Fair attracts many thousands of visitors from central and eastern Europe and the Balkans and its river trade has increased tenfold within the last decade. The city is of interest to scientists since I. O. Segner, the physicist was born there.

The castle was originally erected by the Slav ruler, Wratislaw (Bretislav). The town was known to the Romans as *Posonium (hence the Hungarian name,* Pozsony) whilst the German name is Pressburg. Mr. Benyovszky, editor of the *Grenzbote*, is fully qualified to write a volume upon his native city of which he feels justly proud. He has compressed the history of the city into a single chapter and then goes on to describe the various quarters, streets and thoroughfares, directing attention to buildings and other objects of interest. Among the edifices erected *since the war are the Komensky University* (named after the mediaeval Slovak pedagogue) and the imposing Zemedelské Museum or Agricultural Institute.

The author goes on to describe the places of interest in the neighbourhood of Bratislava and gives much useful information to *travellers. It may be mentioned that there* are excellent rail, river and air service connecting the capital of Slovakia with al parts of Europe.

Mr. Benyovszky's book is indispensable to visitors to Bratislava and should be read by all interested in Central European affairs.

J.G.F.D.

Die Glykoside. By DR. J. J. L. VAN RIJN. Second enlarged edition by PROF. HUGO DIETERLE. Pp. viii + 620. Berlin : Gebruder Borntraeger. 1931. Price 48 marks.

Dr. van Rijn's well-known monograph on the natural plant glucosides has now been revised and extended by Prof. Dieterle. After a short account of the nature and characteristics of glucosides the subject is arranged in the botanical orders. Thus the glucosides found in species and genera in, say, papaveraceae are described in one section. Altogether, glucosides have been identified in 93 natural orders from cycads and conifers to compositae. Over a thousand individual glucosides are described and it is evident that the authors have made a thorongh search through the chemical and biological literature in compiling and classifying their lists. It is perhaps significant that plants of each genus or order elaborate their own characteristic glucosides which are seldom found in other natural orders.

The physiological and pharmacological importance of these natural compounds of the carbohydrates with other organic (aliphatic and aromatic) groups is coming more and more to be realised. Many glucosides are already in use as potent drugs. The range available is continually being extended and chemists and biologists should be grateful to Dr. van Rijn and Prof. Dieterle for their comprehensive treatise on these bodies.

PUBLICATIONS RECEIVED.

In the last two issues of *Memoirs* of the Kyoto University College of Agriculture are the following articles.

Studies on Proteins. X. Does the Glutenin differ in character in Different Wheats?

XI. On the Gliadin in Different Forms of Wheat. By KINSUKE KONDO and TSUNETOMO HAYASHI.

XII. On the Globulins of Polished Rice. By K. KONDO and TOSHIO ITO.

The Conductivity of Alkali-Glutinate. By TSUNETOMO HAYASHI.

The Effect of the Carbon-Nitrogen Ratio on the Decomposition of Organic Matter in the Soil. I. Effects of Nitrogen Compounds on Decomposition of Carbon Compounds.

II. Effect of Carbon Compounds on Decomposition of Soluble Nitrogen Compounds. By SHIGERU OSUGI, SHUJI YOSHIE and JUN'ICHI KOMATSUBARA.

The Constituents of Manures and the Rate of their Decomposition in the Soil. By S. OSUGI and S. YOSHIE.

Forthcoming Events.

FRIDAY, MAY 15.

PHYSICAL SOCIETY. Imperial College of Science, S.W.7, at 5 p.m.

INSTITUTE OF CHEMISTRY. Belfast and District Section. Royal Belfast Academical Institution, at 7.30 p.m. Annual General Meeting.

ROYAL INSTITUTION, 21, Albemarle Street, W.1, at 9 p.m. "Experimental Aspects of Hydrogen Ion Concentration," by J. C. Phillip, O.B.E., D.Sc., F.R.S., F.R.S.

TUESDAY, MAY 19.

THE INSTITUTE OF PHYSICS. Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2, at 4.10 p.m. "Physics in Relation to the Development of the Internal Combustion Engine," by Alan E. L. Chorlton, M.Inst. C.E.

WEDNESDAY, MAY 20.

SOCIETY OF GLASS TECHNOLOGY. London at 2 p.m.

ROYAL MICROSCOPICAL SOCIETY. B.M.A. House, Tavistock Square, W.C.1, at 8 p.m.

THURSDAY, MAY 21.

CHEMICAL SOCIETY. Ordinary Scientific Meeting. Burlington House, Piccadilly, W.1, at 8 p.m.

COKE OVEN MANAGERS' ASSOCIATION. Northern Section, Armstroug College, Newcastle. "Reactivity of Coke," by Dr. J. H. Jones.

INSTITUTION OF ELECTRICAL ENGINEERS. Irish Centre (Dublin). Trinity College, Dubliu, at 7.43 p.m. Annual General Meeting.

INSTITUTION OF MINING AND METALLURGY. General Meeting. Burlington House, Piccadilly, W.1, at 5.30 p.m.

FRIDAY, MAY 22.

ROYAL INSTITUTION, 21, Albemarle Street, W.1, at 9 p.m. "X-Ray Investigations of the Structure of Liquids," by Sir William Bragg, K.B.E., M.A., D.Sc., F.R.S., M.R.I.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latent Patent Applications.

11,701.—I. G. Farbenindustrie Akt.-Ges. —*Manufacture of ortho-hydroxyinaphthenes.* April 20.

11,957.—I. G. Farbenindustric Akt.-Ges. —Manufacture of ortho-hydroxindolcarboxylic acids of benzene and napthalene series. April 22.

11,959.—I. G. Farbenindustrie Akt.-Ges. —*Manufacture of mono- and dicarboxylic acids of the diphenyl series.* April 22.

Specifications Published.

346,677.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture and production of condensation *products containing nitrogen.*

346,849.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of vat dyestuffs of the anthraquinoneacridone series.

346,883.—Riley, R., and Imperial Chemical Industries, Ltd., Hydration of *acetylene to acetaldehyde.*

Abstract Published.

342,668.—Formaldehyde polymers, Schilt, W., 3, Badstrasse, Zurich, Switzerland.

Solid combustible polymers of formaldehyde which can be used as fuel for automatic lighters are obtained by treating formaldehyde or incombustible polymers thereof such as paraformaldehyde with sulphuric or phosphoric acids of at least 2 per cent. concentration at temperatures not exceeding 60° C. The lower the reaction temperature, the greater should be the concentration of the acid employed, for example, 20-30 per cent. sulphuric acid may be used to treat formaldehyde or its polymers at normal temperatures for several hours, or paraformaldehyde may be treated with 5-25 per cent. sulphuric acid at 55-60° C. for 1-3 hours. The products can be pressed into shaped pieces. According to examples (1) formaldehyde solution is mixed with concentrated sulphuric acid and left for 10-20 hours; the precipitated product is filtered off, washed with water and dried, (2) paraformadehyde is treated with 30 per cent. sulphuric acid, allowed to stand for 10 hours, and the product is filtered off and washed free from acid; the mother liquor containing sulphuric acid may be used to convert further paraformaldehyde by heating it therewith in a closed vessel for an hour at 60° C., and (3) paraformaldehyde is mixed with 45 per cent. phosphoric acid and allowed to stand for 50 hours at 25° C.; water is added, and the product is filtered off, washed, and dried. Specifications 25830/13 and 247,955, (both in *Class* 2 (iii), Dyes, etc.), are referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

JAPENCO.

521,540.—Chemical substances used in manufactures, photography, or philosophical research, and anticorrosives. — Dirk Vettewinkel, *trading as Japanol Enamel Co.*, Cuba House, Enfield Highway, Middlesex, April 29.

CONFESSIONS OF GREAT SOULS.

By the Rev. J. E. Roscoe, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

The work is handsomely bound, and has a copious index for easy reference, and the work, containing as it does, the gems of thought on some of the world's greatest thinkers, will form an acquisition to any library.

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THE CHEMICAL NEWS

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A list of various Important Scientific Books for Sale at usually ***less than half published prices*** *will be sent on application to the Manager, Chemical News, Merton House, Salisbury Square, London, E.C.4.*

THE OPTICAL SPECTRUM OF RHENIUM (DVI-MN) AND ATTEMPTS TO IDENTIFY THIS ELEMENT IN THE STARS.

By F. H. LORING.

W. F. Meggers (see *Journ. Franklin Inst.*, 1931, 211, 373-374) has determined the optical spectrum of rhenium (Dvi-Mn) from one gram of pure potassium perrhenate, given by Dr. A. V. Grosse of the Institute of Technology, Berlin, the measurements of the arc spectrum being in the region of 2300 A in the ultralviolet to 8800 A in the infra-red. Approximately 2,000 lines have been mapped, all of which are new to spectroscopy, not being identifiable with lines emitted by any other known atoms.

Table I shows the principal lines and their relative intensities, the wave-lengths being in Angström units. Many of the lines are complex, having from two to six components. This information is taken from the communication to the above journal by the Director of the U.S. Bureau of Standards.

TABLE I.

2887.66	(60)	4522.71	(100)	
2992.35	(50)	4791.42	(80)	
2999.59	(80)	**4889.15**	**(2000)**	**Blue**
3067.38	(50)	4923.93	(80)	
3399.31	(60)	5270.98	(400)	
3424.61	(120)	5275.57	(1000)	
3451.88	(200)	5834.31	(300)	
3460.46	(600)	6307.70	(75)	
3464.72	(400)	6321.88	(100)	
3725.76	(50)	6350.73	(50)	
4136.45	(100)	6605.17	(60)	
4144.36	(60)	6813.37	(100)	
4222.46	(200)	6829.91	(120)	
4257.61	(50)	6971.48	(60)	
4358.69	(50)	7024.10	(50)	
4394.37	(80)	7640.92	(80)	
4513.31	(300)	7912.90	(50)	
4516.62	(50)			

The strongest line, 4889.15, is undoubtedly the most sensitive one for the spectro-chemical identification of this element. This blue line and the green lines 5270.98A, 5275.57A, are the most brilliant lines in the visible spectrum, to quote from the above communication.

These 35 lines are stated to be for the neutral atom.

It is of passing interest to note that the newly-discovered element comprises atoms of masses 185 and 187 in such proportion as to give an atomic weight of 186.2

(Aston, *Nature*, 1931, *127*, 591) agreeing with Hönigschmid's value, 186.31, determined chemically.

Rhenium (Dvi-Mn) is said to be extremely rare, and as a rough estimate probably it constitutes about *one part in a million* × *million* of the earth's crust, *i.e.*, 10^{-12}.

W. Meidinger (*Zeit. für Physik*, 1931, *68*, 331-348) has also determined many lines of rhenium (Dvi-Mn) which are given in *Table II, being copied from the half-tone* figures in the paper.

TABLE II.

2600.1	3204.2
2608.5	3235.9
2611.6	3259.4 - 58.8
2636.7	3268.4
2652.0	3296.7
2654.1	3322.3
2663.5	3338.1
2674.3	3342.2 (Fe)
2688.5	3344.3
2715.4	3346.2
2732.2	3419.4
2752.9	3437.5
2758.0	3451.9 strong
2770.4	3460.6 strong
2783.4	3464.8 strong
2814.7	4047.2
2819.8	4057.8
2850.7	4075.8
2887.5	4221.1
2895.8	4241.5
2909.85	4257.8 strong
2927.4	4283.3
2943.1	4302.8
2965.9	4304.6
2992.4	4318.7
3004.1	4332.3
3030.6	4392.2
3069.95	4394.3
3082.4	4425.2
3082.35	4513.0 strong
3088.8	4516.2
3108.9	4522.2
3110.9	4553.7
3118.2	4605.4
3121.4	4791.6
3151.7	4889.1 wide and strong
3153.7	
3158.2	4914.7
3164.3	4923.9
3185.8	4934.1

F. J. M. Stratton in his ASTRONOMICAL PHYSICS (1925) pp. 200-203 gives unidentified lines of the star η *Carinæ* (or η *Argus*), which is classed with stars of *peculiar spectra*, as follows :—

TABLE III.

4244.09	4448.
4276.85	4457.80
4287.29	4474.70
4358.94	4728.17
4413.87	4814.60
4416.26	4889.46

These values (Table III) are in I.A. wavelengths. The literature Stratton cites in this connection is :—

Moore and Sanford, *Lick-Obs. Bull.*, 1913, *8*, 59.

Lunt, *M.N.R.A.S.*. 1919, *79*, 621.

It will be seen that there are two star lines agreeing closely with the arc lines of rhenium (Dvi-Mn), namely, 4358.94 and 4889.46. The very great intensity in one case and the very low relative intensity in the other, with no other coincidences (see Table I), tends to defeat the double agreement; but, it can be said that the strongest line of this element agrees closely with one in the spectrum of η *Carinæ*, the other agreement being discounted for there are no other agreements with strong intermediate lines.

H. Schober, in a letter in *Naturwissenschaften* of April 3, 1931, p. 310 (vol. *19*) attempts to show that some of Rowland's lines (PRELIMINARY TABLE OF SOLAR SPECTRUM WAVE-LENGTHS, Chicago, 1896) agree with those of rhenium (Dvi-Mn) (see The Ultimate Lines in the Arc-Spectrum of Rhenium, by H. Schober and J. Birke, *Naturwiss.*, 1931, *19*, 211-212) the following comparisons being given :—

TABLE IV.

Rhenium.		Sun.	
3424.76	(20)	3424.73	(000)
3452.07	(30)	3452.06	(3)
3460.69	(100)	3460.66	(0000N)
3464.93	(50)	3464.96	(0000)
4889.38	(100)	fehlt	
5271.18	(20)	5271.22	(00)
5275.79	(30)	5275.79	(0000)

This author remarks :—

Auffallend ist allerdings das Fehlen sowohl der stärksten Linie des Rheniumspektrums 4889.38 als auch die teilweise etwas hohe Intensität koinzidierender Fraunhoferlinien.

Schober refers to Meggers' lines as first published in the *Physical Review* of January 15, 1931; vol. *37*, p. 219.

Commenting on the above, the identification of rhenium (Dvi-Mn) in the two stars (our sun being one) is not entirely satisfactory for reasons that are obvious.

THE COLLINSICS OF MINERALS. XIX

By Hawksworth Collins, B.A. Camb.

The relative volume (15.53) of sulphur has now been shown forty times to have optical refractivity 5.75; but in the eight collinsics given in Table XLIV, which are only a few out of some hundreds, it is evident that the O.R., instead of being 5.75 may be 15.53. The difference between these two O.R.s is fortunately very great, so that it is quite easy to distinguish the two cases.

The fact that the R.V. 15.53 may frequently have an O.R. 15.58 makes the tenth example of such a state of affairs, although only 80 elements have so far been brought into the collinsics.

These discoveries are all due to the Gladstone-Dale formula instead of to the Lorentz, which was tried for many years and led to nothing.

Table XLIV.

Eight Collinsics Containing Sulphur.

(229) Boussingaultite $Am_2MgS_2O_8.6H_2O$

Theor. S.G. **1.7** Obs. S.G. 1.68–1.72 D

Am_2 Mg S S O_4 O_4 Aq_6

98.3323 = 0.46416(23.87$_2$ + 8.71 + 15.53 + 15.53 + 7.53$_4$ + 2.51$_4$ + 14.03$_6$)

Theor. R.I. **1.46416** Obs. R.I. 1.4677 D

98.3335 = 9.81$_2$ + 6.0015 + 5.75 + 15.53 + 1.654$_4$ + 1.346$_4$ + 6.572$_6$

(230) Potassium Magnesium Sulphate $K_2MgS_2O_8.6H_2O$

Theor. S.G. **2.024** Obs. S.G. 2.024 Topsoe

K_2 Mg S S O_2 O_6 Aq_6

93.077 = 0.46855(22.29$_2$ + 8.71 + 15.53 + 15.53 + 7.53$_2$ + 2.51$_6$ + 14.03$_6$)

Theor. R.I. **1.46855** Obs. R.I. 1.4629–1.4755 C.R.P.C.

93.0775 = 7.49$_2$ + 6.0015 + 5.75 + 15.53 + 1.654$_2$ + 1.346$_6$ + 6.572$_6$

(231) Potassium Copper Sulphate $K_2CuS_2O_8.6H_2O$

Theor. S.G. **2.13** Obs. S.G. 2.137 Schiff

K_2 Cu S S O_4 O_4 Aq_6

100.904 = 0.4872(22.29$_2$ + 7.13 + 15.53 + 15.53 + 7.53$_4$ + 2.51$_4$ + 14.03$_6$)

Theor. R.I. **1.4872** Obs. R.I. 1.4864 C.R.P.C.

100.912 = 7.49$_2$ + 13.22 + 5.75 + 15.53 + 1.654$_4$ + 1.346$_4$ + 6.572$_6$

(232) Ammonium Copper Sulphate $Am_2CuS_2O_8.6H_2O$

Theor. S.G. **1.897** Obs. S.G. 1.891 P & J. 1.925 15° Pett.

Am_2 Cu S S O_4 O_4 Aq_6

105.555 = 0.502(23.87$_2$ + 7.13 + 15.53 + 15.53 + 7.53$_4$ + 2.51$_4$ + 14.03$_6$)

Theor. R.I. **1.502** Obs. R.I. 1.497 C.R.P.C.

105.552 = 9.81$_2$ + 13.22 + 5.75 + 15.53 + 1.654$_4$ + 1.346$_4$ + 6.572$_6$

(233) Ammonium Magnesium Sulphate $Am_2MgS_4O_8.6H_2O$

Theor. S.G. **1.6993** Obs. S.G. 1.696 Gmelin 1.717 4° P & J.

Am Mg S S O O Aq

98.3344 = 0.46417(23.87$_2$ + 8.71 + 15.53 + 15.53 + 7.53$_4$ + 2.51$_4$ + 14.03$_6$)

Theor. R.I. **1.46417** Obs. R.I. 1.4717 C.R.P.C.

98.3335 = 9.81$_2$ + 6.0015 + 5.75 + 15.53 + 1.654$_4$ + 1.346$_4$ + 6.572$_6$

(234) Sulphoborite $2MgSO_4.4MgHBO_3.7H_2O$

Theor. S.G. **2.418** Obs. S.G. 2.416 Thad.

Mg_6 S S H_4 B_4 O_4 O_{16} Aq_7

157.348 = 0.542(8.71$_6$ + 15.53 + 15.53 + 5.76$_4$ + 3.865$_4$ + 7.53$_4$ + 2.51$_{16}$ + 14.03$_7$

Theor. R.I. **1.542** Obs. R.I. N_m 1.540 N_g 1.544 W

157.357 = 6.0015 + 5.75 + 15.53 + 2.613 + 3.865 + 1.654 + 1.346 + 6.572

(235) Glauberite $Na_2CaS_2O_8$

Theor. S.G. **2.795** Obs. S.G. 2.767 Brei. 2.85 D

$$\begin{array}{l} \qquad\qquad\qquad\quad Na_2 \qquad Ca \qquad S \qquad S \qquad O_2 \qquad O_6 \\ \mathbf{50.918 = 0.512(11.865_2 + 14.54 + 15.53 + 15.53 + 7.53_2 + 2.51_6)} \end{array}$$

Theor. R.I. **1.512** Obs. R.I. 1.515 S

$$\mathbf{50.914 = 3.865_2 + 10.52 + 5.75 + 15.53 + 1.654_2 + 1.346_6}$$

(236) Sulphur S

Theor. S.G. **2.0605** *Obs. S.G.* 2.05 *Kars.* 2.063 *Devi.*

$$\begin{array}{l} \qquad\qquad\quad S \\ \mathbf{15.53 = 1.0(15.53)} \end{array}$$

Theor. R.I. **2.0** Obs. R.I. 1.9505 D. 2.029 D

$$\mathbf{15.53 = 15.53}$$

TABLE XLV.

THE VOLOPTICS OF THE FIRST 236 COLLINSICS.

	R.V.	O.R.	Number of Times
Ag	13.29	20.79	6
Al	9.05	7.865	115
Al	12.05	4.863	32
Am	23.87	9.81	9
As	19.58	17.75	41
B	3.865	3.865	31
Be	4.62	3.733	20
Br	18.05	18.05	1
C	8.0	3.333	26
Ca	14.54	10.52	92
Ca	13.25	13.25	26
Ca	12.24	15.6885	5
Cl	15.085	10.82	32
Cr	21.73	21.73	3
Cu	7.18	13.22	46
Cu	9.54	14.77	27
F	5.42	0.26	24
Fe	10.08	19.58	25
H	5.76	2.613	1066
I	17.75	17.75	10
K	22.29	7.49	19
Mg	8.71	6.0015	63
Mg	7.51	5.031	17
Mn	13.02	11.53	28
Mn	11.53	13.02	15
N	3.8	3.8	4
Na	11.865	3.865	68
Ni	11.53	11.53	2
O	7.53	1.654	312
O	4.45	1.747	267
O	2.51	1.346	1751
P	14.56	10.51	66
Pb	19.81	35.450	31
Pb	17.42	28.264	36
S	15.53	5.75	40

	R.V.	O.R.	Numbers of Times
S	15.53	15.53	8
Se	21.29	17.43	4
Si	18.91	10.461	53
Si	17.61	9.625	61
Si	13.83	9.78	63
Si	13.02	11.53	76
Sr	19.56	19.56	4
V	17.76	17.76	1
Zr	15.59	21.59	12

The above table is intended to be read as follows :—

When an atom of Ag is found to have the relative volume 13.29 in any substance, its optical refractivity is always 20.79; and this voloptic has already occurred six times in the first 236 collinsics, etc.

The R.V. and O.R. of ammonium will be explained when organic substances are under consideration.

GEODETIC SURVEY MEASUREMENTS.

Accurate measurements can be made across country by means of a measured line on the ground and a system of triangles. The triangulation of the Geodetic Survey of Canada, Department of the Interior, is conducted with the greatest degree of accuracy. Its usage involves the determination of the size and shape of the earth, the location of international and provincial boundaries, and furnishes points of control for the general maps of the country. Adjusted geodetic points in great numbers are available to the public in every province of the Dominions.

DUST IN CHIMNEY GASES.

The Nature of Particles.

By A Well-Known Engineer.

In the past few years much information has been made available concerning what is rapidly becoming one of the most important aspects of the operations of steam boiler and power stations and furnace equipment in general, that is dust removal from chimney gases. This is largely due to the pioneer work of Davidson and Co., Ltd., of Belfast, whose long continued researches have resulted in the perfecting of their new centrifugal and gravity dust collector of which more than 500 are already in some 100 power stations, whilst the total number supplied is nearly 1,000, for use in all kinds of dust collecting application, especially as regards the chemical industries.

An interesting aspect of the subject is *the composition of the average fine dust* contained in chimney gases both from mechanical stoking and pulverised fuel firing, of which it may be stated the collectors will remove 70-95 per cent. of the total according to the conditions. As a result of the taking of hundreds of microphotographs such dust is found to contain white, round, opaque, cellular bodies, transparent glass-like particles, and yellow to brown crystals, all of which are ash *particles that have been melted.* A portion of the dust both from stoker fired and pulverised fuel boilers will also be found to consist of coked (partially burnt) coal of various shapes and sizes, black opaque globular bodies of unknown origin, and unburnt particles.

A large proportion of the white opaque globular bodies and transparent particles are sufficiently light to float on water, and incidentally this shows the difficulties to trying to remove dust from gases by the use of water sprays. The opaque white particles usually predominate in the dust from pulverised fuel boilers being especially abundant in the dust from boilers using turbulent burners. It seems clear these particles are formed from the ash portions having a high melting point and probably result from very fine particles in the plastic or semi-molten stage sticking together in their passage through the combustion chamber. Thus the complete globules often have smaller ash masses adhering or sometimes specks of unburnt coal. On the other hand the clear glass-like particles are formed from the lower melting point ash, which has fused completely, being hollow spheres with extremely thin walls of molten silicates (glass). They are most numerous in pulverised fuel fired dusts, but there is no hard and fast rule, and such glass-like bodies are to be found with every class of coal firing, even in the soot from a domestic fire. The suggestion has been made that these fragile glass-like bodies result from the passage of gases and vapours from a burning coal particle through an outer skin of molten ash. In general both the hollow glass-like spheres and the white opaque particles will float on water, but the former are very fragile and the later may become water-logged, so that portions of the hollow glass-like spheres and some of the white particles will be found amongst the dust which sinks. In the latter case, however, the bulk of the dust which sinks will be found to be black, hollow globules of unknown origin having thick walls which perhaps are highly bituminous coal that has been melted but not carbonised to any appreciable extent, coke in various amorphous forms, mostly of irregular shape, and also coke in the form of rectangular pieces, lightish in colour, whilst unburnt coal is represented by black needles with sharp edges.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

Applications for Licences in April, 1931.

The following statement relating to applications for licences under the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 511, of which 424 were from merchants or importers. To these should be added 5 cases outstanding on the 31 March, making a total for the month of 516. These were dealt with as follows :—

Granted—478 (of which 467 were dealt with within 7 days of receipt).

Referred to British makers of similar products—32 (of which 29 were dealt with within 7 days of receipt).

Outstanding on 30 April—6.

Of the total of 516 applications received, 496 or 96 per cent. were dealt with within 7 days of receipt.

BRITISH CHEMICAL STANDARDISATION.

The inaugural meeting of the Provisional Council for the Chemical Division of the proposed new "Standards Association of Great Britain" which was held on May 7, 1931, at the offices of the Association of British Chemical Manufacturers, marks the successful completion of the negotiations which were initiated nearly a year ago. In June, 1930, a large and representative Conference of chemical interests, convened by the Association of British Chemical Manufacturers, unanimously resolved that a British Chemical Standardising Body should be constituted which would co-ordinate and accelerate the work of standardisation in the chemical field and do for chemistry what the British Engineering Standards Association has done and is doing so successfully for engineering. The Conference also agreed that in the interests of efficiency and economy, there should be a single national organisation embracing all forms of standardisation, and that an Ad Hoc Committee should be formed to explore the situation as regards chemical standardisation in collaboration with the British Engineering Standards Association. A representative Committee was formed under the Chairmanship of Dr. E. F. Armstrong, the Chairman of the Association of British Chemical Manufacturers, with Mr. J. Davidson Pratt, the General Manager, as Secretary, and set to work at once to devise a scheme which would permit of the incorporation of chemical standardisation with the British Engineering Standards Association in a new Standards organisation designed to meet the needs of industry as a whole. The points which the Committee regarded as of fundamental importance were that the chemical interests should be on an equal footing with those of engineering, and that the new organisation should possess the flexibility necessary to enable any desired standardisation to be carried out efficiently and expeditiously.

The various discussions which took place with Mr. Le Maistre, the Director of the British Engineering Standards Association, were conducted in a spirit of the greatest mutual co-operation and assistance, and agreement was finally reached on a comprehensive scheme of organisation which fully met the views of both parties. The title for the new organisation presented some difficulty, and it was finally agreed that the title "Standards Association of Great Britain" met all requirements and was free from objections on the part of other industrial organisations. As the controlling body there will be a General Council to deal with matters of broad policy and general interest; this will be constituted essentially by the election of 9 members from each of the Divisions and by the nomination of a representative each of the Board of Trade, the Department of Scientific and industrial Research, the Federation of British Industries, the Association of British Chambers of Commerce and the Institution of Civil Engineers on behalf of the founders of standardisation. There will be four coequal main Divisions, each controlled by a Divisional Council, for Engineering, Chemistry, Building and Textiles. Each of these Divisions will be autonomous subject to the broad policy laid down by the General Council, and will be free to organise itself in the manner which it finds most suitable for carrying out efficiently and expeditiously the objects of standardisation within its particular field. The Engineering Division will consist of the present British Engineering Standards Association, with the exception of those elements which will now find a more appropriate place under one of the other Divisions. The new scheme is broad in its conception and simple in constitution, and meets all the requirements of the chemical interests. It has been unanimously accepted not only by all the chemical organisations which participated in the initial Conference, but also by practically every other body likely to have a direct interest in the work of chemical standardisation. Active steps are now being taken by the British Engineering Standards Association to obtain the necessary Supplemental Charter to give effect to the new organisation, while the new Bye-Laws are already in final form.

At the inaugural meeting of the Provisional Council of the Chemical Division on May 7, it was decided that the membership of the Chemical Council should not exceed 40, and that not more than 5 of these places should be reserved for the co-option of individuals whose services are likely to be of special assistance to the Council. The constitution of the Council as finally agreed is as follows :—

Admiralty.
Air Ministry.
Association of British Chemical Manufacturers.
Association of Tar Distillers.
British Chemical and Dyestuffs Traders' Association.
British Chemical Plant Manufacturers' Association.
Board of Trade.
Ceramic Society.
Chemical Society.
Chemical Research Laboratory (D.S.I.R.)
Federal Council for Chemistry.
Food Manufacturers' Federation.
Government Laboratory.
India Rubber Manufacturers' Association.
Institute of Brewing.
Institute of Chemistry.
Institute of Fuel.
Institution of Petroleum Technologists.
International Society of Leather Trades Chemists (British Section).
National Benzole Association.
National Federation of Associated Paint, Colour and Varnish Manufacturers of the United Kingdom.
London Oil and Tallow Trades Association.
Pharmaceutical Society.
Society of Dyers and Colourists.
Society of Public Analysts.
War Office.
Institution of Chemical Engineers, and Society of Chemical Industry (jointly).
Institution of Gas Engineers, and Nationa Gas Council (jointly).
Glass Manufacturers' Association, and Society of Glass Technology (jointly).

Each of the above organisations will nominate one representative with the exception of the Association of British Chemical Manufacturers which will have 5. The above list therefore represents 33 members. Dr. E. F. Armstrong has been elected as Chairman and Mr. W. Rintoul as Vice-Chairman.

The Chemical Council has also given preliminary consideration to the programme of work which it will have to undertake. The actual task of drawing up standards will not be performed by the Council itself; wherever possible, existing organisations which are already engaged on standardisation will be utilised, but where such are not available, suitable technical committees and sub-committees will be formed as required to represent the main interest affected in each particular case.

Thus it will be seen that chemical standardisation has now been put on a proper national basis. There is much work of an urgent nature to be done, but if the chemical interests continue to exhibit the same spirit of loyal co-operation as they have shown in the formation of the new organisation, the success of the venture is definitely assured, and the Chemical Division can look forward to a long period of useful activity on behalf of industry.

KEY INDUSTRIES.

Representations have been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding crude safrol (camphor oil fraction containing not more than 90 per cent. safrol) and diphenyl.

Section 10 (5) of the Finance Act, 1926, is as follows :—

"The Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act, 1921, as amended by this Act, for such period as may be specified in the order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that there is no reasonable probability that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Any communication should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, S.W.1, within one month from the date of this notice.

IRISH FREE STATE—HOSPITAL EQUIPMENT.

The United Kingdom Trade Commissioner at Dublin reports that many hospitals in the Irish Free State have under consideration re construction or re-equipment plans.

A list of hospitals and similar constitutions in the Irish Free State may be obtained by firms desirous of offering goods of British manufacture on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

GENERAL NOTES

THE BRITISH CHEMICAL TRADE WITH CHINA.

According to the British Trade returns a remarkable increase has been secured by British chemicals in the Chinese markets. The exports of Chemicals to China, including Hongkong, in 1913 were valued at £213,516, and by 1929 had risen to £1,591,068. In the pre-war trade returns, exports to China of dyes were not separately distinguished, but in 1929 they were recorded as amounting to £323,673. Chemicals and dyes, therefore, form a very substantial trade for Great Britain and China and constitute more than one-tenth of our total export trade in goods wholly or mainly manufactured to the market. This most satisfactory result for British trade in a highly competitive market is due to the sound system of distribution as well as to the excellence of the products and their competitive prices.

British pharmaceutical chemicals and medicines cannot be regarded as enjoying a similar success, for out of the total import trade into China in 1929 of £1½ millions, Great Britain secured the low share of 13 per cent only. The chief supplier of medicinal preparations to China is Japan, with 40 per cent. of the total imports. The United States secures about 25 per cent. and Germany 20 per cent., the reason for the British failure in this market is the refusal of British manufacturers to recognise that China presents a large market with very individual requirements or to consider China as other than a possible dumping ground for surplus production. There is the further disability of high price, from which British products suffer when in competition with those of Germany, Japan or the United States. These countries appear to supply medicines of a quality quite suitable to the market, and they pack and label their preparation in such a way as to make a special appeal to the Chinese.

The distribution adopted by American and Continental manufacturers for medical goods is also much better than our own. Our competitors have either their own branches in China or employ their own representatives working through established distributors in the drug trade. Many British medicines, however, are distributed in China through general merchant houses not specialising in these articles.

ECONOMIC CONDITIONS IN POLAND.

The continued unfavourable economic position in Poland has been chiefly due to the world depression, although certain local factors have also contributed, possibly in a greater degree than during the immediately preceding years.

As regards finance, there was a considerable depletion of the gold reserve of the Bank of Poland, and although no fear is yet entertained in banking circles for the stability of the official exchange, there has been a general deterioration in the monetary situation.

The chapter of the Report devoted to industry shows that the position became less favourable during 1930 in all its branches. There was also a noticeable rise in unemployment at the end of the year. However, although reduced local consumption and increased competition in export markets caused a general diminution of production, the balance of Poland's foreign trade remained favourable practically throughout the year, exports exceeding imports in value by 187,271,000 zloty. (£4,320,000). These results were due in part to the formation of special export organisations, to the introduction of standardisation in certain classes of foodstuffs, to a system of export premiums, etc. Although Soviet competition was not felt to any extent in the home market the Polish timber trade suffered severely from this competition in the United Kingdom, German and other markets. There was, however, a slight expansion of other exports to the United Kingdom.

Imports also fell off in volume owing to the restriction of purchasing power. The Section of the Report dealing with the United Kingdom's share in import trade shows that this country maintained its position as regards total percentages of imports ,though the actual figures showed a decline. The value of British imports amounted to £4,080,000 compared with £6,113,000 in 1929.

The Commercial Treaty concluded with Germany was ratified by both Chambers of the Polish Parliament in February last.

The agricultural position is shown to have deteriorated during the course of the year, corn prices having fallen yet further and difficulties having arisen in the export of livestock etc., due to importation restrictions in several countries.

The railways, besides suffering from the effects of the general depression, had to meet serious competition from the expansion of road motor traffic.

Cheap working capital for industry, commerce and agriculture, internal stability, and increased purchasing power, are needed to bring back prosperity to the economic life of Poland. It is, however, hoped that an improvement in world conditions may do much towards the same end.

MARKETS FOR PHARMACEUTICAL CHEMICALS IN MEXICO.

A confidential report on the market for pharmaceutical chemicals in Mexico has been prepared by the Department of Overseas Trade from information furnished by H.M. Consul General at Mexico City and issued to firms whose names are entered on its Special Register.

United Kingdom firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number F.X. 1130 should be quoted.

MARKETS FOR CHEMISTS' AND DRUGGISTS' GOODS.

Report on the Trade in Peru.

A confidential report on the market for chemists' and druggists' goods in Peru has been prepared by the Department of Overseas Trade from information furnished by the Commerical Secretary to His Majesty's Legation at Lima, and issued to firms whose names are entered on its Special Register.

United Kingdom firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference F.X. 1115 should be quoted.

ARTIFICIAL GRAPHITE.

Artificial graphite, an electric furnace product, is made near Niagara Falls, Ontario.

BOARD OF TRADE ANNOUNCEMENT.

Key Industries.

A representation has been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding methylene chloride.

Section 10 (5) of the Finance Act, 1926, is as follows :—

"The Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act, 1921, as amended by this Act, for such period as may be specified in the order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Any communication should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, S.W.1, within one month from the date of this notice.

MARKETS FOR CHEMICAL FERTILISERS.

Report on Trade in Salvador.

A confidential report on the market for chemical fertilisers in Salvador has been prepared by the Department of Overseas Trade from information furnished by H.M. Consul at San Salvador and issued to firms whose names are entered on its Special Register.

United Kingdom firms desirous of receiving a copy of this report, together with particulars of the Special Register Service of information and form of application for registration, should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number F.X.1129 should be quoted.

CANADIAN NICKEL.

Canadian nickel is obtained almost entirely from nickeliferous pyrrhotitechalcopyrite ores of tre Sudbury district, Ontario.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

May 7.

The following papers were read :—

The Measurement of Actinic Erythema Produced by Ultra-Violet Radiation with Special Reference to the Latent Time. By M. D. WALLER. Communicated by Sir Edward Sharpey-Schafer, F.R.S.

Consistent results regarding the biological action of ultra-violet radiation, as measured by the resulting skin erythema, can be obtained provided the precautions described in the paper are taken. The relation between the latent time (*i.e.*, the time which elapses between exposure and the first visible signs of erythema) and the time of exposure to radiation of a constant intensity, is exhibited in graphical form. The curve terminates at a least exposure corresponding to a longest latent time; beyond this the exposures are not sufficient to produce visible erythema. The latent time tends to a limiting value as the time of exposure is increased. The curve is very similar to that which is obtained when the time of exposure to light of a photographic plate is plotted against the time which elapses before the first appearance of the image during development.

The latent time of erythema, which may vary from about one to seven hours, according to the length of exposure, provides the most accurate and simple way of estimating the effect of ultra-violet radiation on the skin and it is easily measured. Moreover, the difficulty of comparing the results of one observer with those of another, when these are based on the measurement of the degree of erythema are obviated. Observations of the degree and duration of erythema can confirm roughly the results obtained by measuring the latent time.

When it is desired to get the maximum contrasts due to differing conditions of radiation, exposures should be chosen which will lie on the steep part of the curve, corresponding to rapid variations of the latent time with exposure and to slight erythemas which will even visually differ one from another more than will deep erythemas.

The Relation Between Energy Doses of Ultra-Violet Radiation and Actinic Erythema Produced. By M. D. WALLER. Communicated by Sir Edward Sharpey-Schafer, F.R.S.

The purpose of the investigation was to ascertain what relation exists between the effect of radiation from a mercury vapour lamp on the skin as measured by skin erythema and the total amount of radiation energy or " dose " (intensity X time) received.

The paper also gives the relation connecting dose and latest time. The question is of both theoretical and practical importance. It is a particular case of the general problem of how the extent of a biological reaction depends upon the quantity of any kind of radiation (γ, X or U.V. rays) producing it.

Particular attention was paid to the question of how the intensity of the radiation decreases with the distance from the source. The intensities were varied over wide limits (200 :1) corresponding to distances varying from 40 cms. to 5½ m. The effect of a given " dose " of the weak intensity is just as great as that of the most powerful intensity used, and it is concluded that the production of erythema follows the Bunsen-Roscoe law for a photo-chemical action, *i.e.*, the time factor is unity.

If the latent time be plotted against the " dose " made on one part of a subject with the source of radiation constant, but the intensity of radiation varying, the observations lie on a single curve, *i.e.*, if we take a separate series of curves connecting latent time and time exposure as obtained in the previous paper and plot " dose " instead of time of exposure, the separate curves become one. This curve gives the relation between the biological reaction of the skin as measured by the latent time for the production of erythema and the quantity of radiation received.

On the Return of Sensitiveness in Corneal Grafts in Rabbits. By J. W. TUDOR THOMAS. Communicated by T. Graham Brown, F.R.S.

The object of the paper is to examine the factors which determine whether a piece of cornea grafted from one rabbit on the cornea of another becomes sensitive or remains insensitive.

In a series of experiments on corneal grafting, some of the grafts became sensitive and others did not. The results of 29 experiments are analysed.

Some of the grafts were central in position in the cornea, others marginal. Some remained or became clear; others more or less opaque, while one exhibited a central clear area.

Not one of the 21 sensitive grafts was clear, and the opacity in most cases was pronounced; each sensitive graft was found to have become vascularised.

Seven of the eight insensitive grafts were either completely or practically devoid of blood vessels.

Twenty-one out of twenty-three opaque grafts became sensitive, while all the five clear grafts remained insensitive.

The time taken for sensitiveness to return in those grafts which became sensitive, was less in the case of the central grafts, than in the case of the marginal grafts.

The conclusion is reached that the establishment of an afferent nerve supply to a corneal graft depends upon a precedent or concurrent growth of blood vessels in that graft. It does not seem to be necessary that the blood vessels should accompany, or take the same path as the afferent nerves that grow in from the surrounding tissue.

Respiration as a Factor in the Ionic Equilibria Between Plant Tissues and External Solutions. By G. E. BRIGGS AND A. H. K. PETRIE. Communicated by F. F. Blackman, F.R.S.

The conductivity of water containing slices of tissue from carrot root rises at first and then falls to a steady value, which is maintained as long as the tissue is alive. It has been established that the rate of evolution of carbon dioxide by the system follows a similar course to that of the conductivity. After the conductivity has attained a steady value a change in the rate of production of carbon dioxide, induced by a change in the supply of oxygen to the tissue, is accompanied by a similar change in the conductivity of the external liquid.

Theoretical consideration shows that variations in the rate of production of carbon dioxide by the tissue will be accompanied by similar changes in the concentration of hydrogen ions in the tissue. This will result in changes in the degree of ionisation of indiffusible snbstances, such as proteins, with consequent changes in the distribution of diffusible ions, such as K and Cl, between the tissue and the external solution. The final result of this chain of events will be a parallelism between rate of production of carbon dioxide and conductivity of external solution.

The following papers were read in title only :—

Recovery Heat in Muscular Contraction Without Lactic Acid Formation. By MCKEEN CATTELL, T. P. FENG, W. HARTREE, A. V. HILL, F.R.S., AND J. L. PARKINSON.

Muscles poisoned with iodo-acetic acid contract without producing lactic acid. After contraction in oxygen a delayed heat production occurs similar to that which in normal muscles is associated with recovery, though in some cases smaller in amount. Muscles poisoned with iodo-acetic and exhausted show about the normal resting rate of heat production in nitrogen in spite of their inability to produce lactic acid. In oxygen their heat rate may remain for long periods far higher than that of a normal resting muscle. In a twitch, or a short tetanus, the ration of tension developed to heat produced is unaffected by the poisoning. Functional recovery in oxygen after stimulation can be demonstrated under certain conditions in poisoned muscles. The persistence of "recovery" heat when functional recovery has been eliminated suggests that one effect of iodo-acetic acid is to interfere with the mechanism by which energy released in oxidation can be employed in driving the endothermic reactions necessary for functional recovery; it does not interfere with oxidation as such. Normal muscles stimulated to extreme exhaustion have a "recovery" heat only about one quarter of its usual value in relation to the initial heat. Possibly in normal muscles pushed to extreme exhaustion, as in muscles poisoned with iodo-acetic acid, one reason of incomplete recovery is that phosphate set free by the breakdown of creatine-phosphoric acid is "side-tracked" as hexose phosphoric ester and so cannot be recombined with creatine.

Further Investigation of Sweating and Sweat. By A. G. R. WHITEHOUSE. Communicated by J. S. Haldane, F.R.S.

The main object of this investigation has been to study the effects of rise of body temperature and muscular work on the amount and composition of the sweat excreted. The subject of the experiments was a miner who a been more or less acclimatised to working in a hot place. The results show that, for a given rise in body temperature, sweating is facilitated by the perform-

ance of muscular work when compared with sweating produced by the same rise in body temperature with the subject at rest. It seems probable that some product of muscular metabolism is responsible for this, though the connection might be some less direct one. The performance of a moderate amount of work would seem to be accompanied by little rise in the chlorine concentration of the sweat, although a marked increase with time, indicative of fatigue of the sweat-glands, is evident when the subject is at rest and the sweating is simply due to the wet-bulb temperature of the surrounding air. A progressive decrease in the proportion of organic matter to ash is observed as the sweating continues. The chlorine concentration, and also the ratio of chlorine to potassium in the sweat is found to vary for different individuals. The subject was able to maintain a moderate amount of work when the surrounding air had a wet Kata cooling power of about 3, and wet-bulb temperature of approximately 90° F. When the subject was at rest, an air temperature of 95° F. saturated caused little disturbance to regulation of body temperature in the experimental chamber. It must be noted, however, that the temperature of the walls of the chamber in these experiments was slightly below that of the air, so that the conditions are by no means strictly comparable with those obtaining, say, in a mine roadway, where the temperature of the surrounding strata is usually as high as the air temperature.

Experiments on Growth and Inhibition, II. By R. SNOW. Communicated by A. G. Tansley, F.R.S.

In decapitated pea seedlings, which have produced two equal shoots springing from the axils of the cotyledons, if one of the shoots is deprived of its leaves until only those of 1 mm. or less remain, it is rapidly arrested in growth and finally killed. This effect must be due to inhibition coming from the other shoot, for if similar single shoots are similarly defoliated, they grow on rapidly. These results are produced in light too dim for appreciable photosynthesis as well as in good light. They are considered to make it probable that the inhibiting influence that comes from the developing leaves of a shoot, is of a polar nature, so that two such influences coming from two shoots from opposite directions counteract one another. But if one of the shoots is defoliated, the influence coming from the other shoot travels up into it, arrests it, and finally kills it.

Similar results produced, though less rapidly, by darkening a shoot. If another shoot is present on the plant, the darkened shoot is arrested and killed, but if not, it grows on rapidly. The influence coming from developing leaves kills (directly or indirectly) those shoots or parts of shoots that are not in the line between developing leaves and roots and in which it travels towards the apex, and this fact also suggests that it is of a polar nature.

THE CHEMICAL SOCIETY.

Thursday, May 7.

Orientation Effects in the Diphenyl Series. Part IX. The Nitration of 4-Chloro-4'-fluoro- and 4- Bromo-4'-fluoro-diphenyl. By (Miss) E. E. J. MARLER and E. E. TURNER.

4-Chloro-4'-fluoro-diphenyl and 4-bromo-4'-fluoro-diphenyl have been prepared and nitrated.

Influence of Poles and Polar Linkings on Tautomerism in the Simple Three-carbon System. Part II. Prototropy in Bis-quaternary αγ-Propenylenediammonium Salts. By C. K. INGOLD and E. ROTHSTEIN.

In order to investigate the possibility of prototropy in a three-carbon system in which all unsaturation ceases beyond the limits of the ·CH·C :C· group itself, methods for the preparation of salts $\{R_3N·CH_2·CH:CH·NR_3\}^{++}X_2^{-}$ have been elaborated. In particular, a pair of salts containing the isomeric cations $\{MeEt_2N·CH_2·CH:CH·NEt_3\}^{++}$ and $\{MeEt_2N·CH:CH·CH_2·NEt_3\}^{++}$ has been prepared, and the salts proved by degradation to have the respective structures indicated by their methods of synthesis. Although the salts are not identical, each is converted into an equilibrium mixture of both in the presence of hydroxide or alkoxide ions in the cold; the interconversion occurring in the presence of both these catalysts is regarded as prototropic, and not dependent on primary addition to the double linking.

The Photodecomposition of Ozone in Presence of Chlorine. Weak Ozone Mixtures. By A. J. ALLMAND and J. W. T. SPINKS.

Weigert showed that the decomposition $2O_3 \longrightarrow 3O_2$ can be photosensitised for visible light by chlorine. The striking feature of the reaction was that its rate was independent of (O_3) until just before complete decomposition, when it rose.

The reaction has now been followed by measuring the pressure increase. The ozone (usually 8 per cent.) was mixed with chlorine in a H_2SO_4-sealed gas-holder, and the reaction system was ekpt in a thermostat. Glass cells gave reproducible, a quartz cell anomalous, results. The source of illumination was filtered light from a quartz mercury lamp.

On insolation, the phenomena noted by Weigert were observed, and, in addition, an induction period and an after effect. With a low chlorine content and *U. V.* light, the transmission decreased in the early stages of the experiment, and mist formation occurred in the H_2SO_4-dried gases. The rapid rise at the end did not go on if the light were cut off before it was quite complete. In quartz, such phenomena as the after-effect etc. were very marked; there was sometimes a pressure decrease instead of increase, and other anomalies.

Concentrated ozone mixtures. Discussion.

The mist mentioned in Part I was found to yield $HClO_3$ and $HClO_4$. This suggested the intermediate formation of ClO_3 (or Cl_2O_6). Experiments showed that $ClO_2 + O_3 \longrightarrow \frac{1}{2}Cl_2O_6 + O_2$. The same production of ClO_3 had been observed in the corresponding thermal reaction (a chain reaction) by Bodenstein. With high (O_3) and low (Cl_2) the type of behaviour observed with low (O_3) and low (Cl_2) was reproduced, but emphasised. The γ values were far higher (max. 59), there was a tendency to approximate to the $I\frac{1}{2}$ law, and there was a distinct temperature coefficient (about 1.5). The dark reaction was, of course, also greater. γ very rapidly fell while much ozone was still present.

Ozone disappears by three types of reaction—(*a*) a primary reaction—(*b*) an incipient chain reaction of one complete term in the gas phase—(*c*) a chain mechanism of which one constituent reaction takes place on the surface of the cell. Oxygen is liberated chiefly from the walls, in the gas phase, only by the reaction $ClO_2 + O_3 \longrightarrow ClO_3 + {}_2$, shown independently to take place.

The corresponding equations for the rate of reaction and quantum efficiency are given.

Mechanism (*a*) gives $\gamma = 2$, and no dependence on (O_3), λ or *T*. Mechanism (*b*) could add a maximum of 4 to the value of γ. It is responsible for the divergence from $\gamma = 2$, in dilute mixtures, and for the effect of λ. Mechanism (*c*) is favoured by high (O_3) and low (Cl_2); it corresponds with an $I\frac{1}{2}$ relation, and γ should be independent of λ, but dependent on temperature.

The above mechanism accounts satisfactorily for most of the experimental facts. The formation and decomposition of absorbed ClO_3 are responsible for induction period and after effect. The final rise is due to the catalysis by Cl atoms of an adsorbed Cl_2O_6 layer. The rapid fall in γ in the concentrated ozone experiments is due to the fact that O_3 and Cl_2O_6 do not deact as do O_3 and ClO_3, *viz.*, so as to continue a chain. The magnitudes of the various effects ascribed to surface reactions agree with reasonable assumptions on the thickness of the supposed adsorbed film.

The Effect of Intensive Drying on the Rate of Distillation and on the Vapour Pressure of Ethyl Bromide. By J. W. SMITH.

It has been shown that after intensive drying for a few months over phospheric oxide the rate of nonebullitional distillation of ethyl bromide between bulbs at constant temperatures in a sealed apparatus is retarded considerably. The vapour pressure, however, remained unaltered, and no difference could be detected between the vapour pressures of "head" and "tail" fractions after distillation. Ebullition also occurred with considerably more difficulty in the "dried" liquid. The results are interpreted as indicating that the internal equilibrium in the liquid is not disturbed by the intensive drying, but that the effects which have heen observed are due to a form of superheating, probably induced by the removal of some form of nuclei during the phosphorus pentoxide treatment.

SOCIETY OF PUBLIC ANALYSTS.

An Ordinary Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, May 6, the President, Dr. J. T. Dunn, being in the chair.

Certificates were read for the first time in favour of: Raymond Merefield Edwards, B.Sc., Llewelyn John Howells, B.Sc., Donald Neil McArthur, D.Sc., Ph.D., F.I.C., F.R.S.E., James Sword, M.A., B.Sc., Ph.D., A.I.C.

Certificates were read for the second time in favour of George Brown, A.I.C., Charles

Louden, B.Sc., A.I.C., Charles Percy Money, B.Sc., F.I.C., Martin Priest, F.I.C., Arthur Goodyear Simpson. M.A., Gerrish Smith.

The following were elected Members of the Society :— K. N. Bagchi, B.Sc., M.B., D.T.M., William Nelson Bradshaw, B.Sc., Adrian Joseph Clifford Lickorish, F.I.C., Ernest Grenville Purser, B.Sc., A.I.C., and William Waddell Robson.

The following papers were read and discussed :—

Demonstration of a New Development in Filter Paper. By E. J. Guild.

The paper contains at least 99 per cent. of alpha-cellulose, with about 0.04 per cent. of ash. It is extraordinarily strong when wet and offers great resistance to alkaline solution, such as caustic soda, etc. It is suitable for the rapid filtration on a large scale of coarse or gelatinous substances, and is suitable for all but the most delicate analytical work.

The " Rope " Spore Content of Flour and its Significance. By A. J. Amos, B.Sc., A.I.C., and D. W. Kent-Jones, Ph.D., B.Sc., F.I.C.

A method of determining the rope spore content of flour is described, but it is shown that far less importance must be attached to the rope spore content than to the technique adoped in the bakery as a factor in the production of ropy bread. The conditions which tend to aggravate rope trouble in bread which has been stored under conditions favourable to the development of the disease have been separately investigated.

The Separation of Tin from Tantalum and Niobium. By W. R. Schoeller, Ph.D., and H. W. Webb. (Work done under the Analytical Investigation Scheme.)

For the separation of small amounts of tin from much earth acid, Giles's process (fusion with potassium carbonate, solution in citric acid, precipitation of tin as sulphide) is shown not to be suitable for earth-acid minerals. Schoeller and Powell's process (fusion with bisulhpate, solution in tartaric acid, treatment with hydrogen sulphide, collection of insoluble residue and sulphide precipitate) has been found to be serviceable. For the separation of small amounts of earth acid from much tin, a method of separation has been based on the reduction of the tin oxide by hydrogen. Finally, the separation of earth acid, tin oxide, and silica is discussed.

A New Method for Detecting Decomposition Products in Anæsthetic Chloroform. By N. L. Allport, A.I.C.

The decomposition of medicinal chloroform, resulting in phosgene formation, leads to the presence of free hydrochloric acid due to action on the alcohol which is added as a preservative. The silver nitrate test will not detect less than 10 parts of free acid per million. A new test capable of detecting 1 part of free hydrochloric acid in a million parts of chloroform is based upon the condensation of resorcinol and vanillin by the free hydrochloric acid, with the formation of a red acidic dye. By subsequent treatment with alkali a pink aqueous layer is obtained, the intensity of the coloration varying with the quantity of impurity present.

Contaminations in Morphine deposited in the British Pharmacopeia Process for the Analysis of Opium. By J. N. Rakshit, F.I.C.

The morphine obtained in the determination of the alkaloid by the B.P. process contains from 5 to 6 per cent. of other alkaloids consisting principally of codeine. A modified method is described in which a lime solution of the opium, prepared according to the B.P. process, is extracted with benzene prior to precipitation with ammonium chloride. This yields a much purer morphine than the original process.

ROYAL AGRICULTURAL SOCIETY.

May 6.

Mr. Fred Smith (Chairman) in his report to the chemical committee stated that the list of samples analysed for members dnring the month of April by Dr. Voelcker had been submitted. The Committee gave a general approval to the proposals of the Fertilisers and Feeding Stuffs Act Advisory Committee as contained in their second report. They viewed with special satisfaction the fixing of a definition of "Barley meal "—a definition which, they believed, would tend to the improved quality of what is sold under that name. The Committee remarked, however, that two different classes had been included under the name barley meal, *viz* :—(*a*) Barley Meal, (*b*) Barley Meal, Grade 2. The Committee would like to have seen the requirements more stringently drawn, the name " Barley Meal " being confined to the products obtained by grinding barley of reasonably pure nature, but not applied, with or without qualification, to the produce of barley that may have up to 10 per cent. of matter other than barley.

NOTICES OF BOOKS.

An Outline of the Universe. By J. G. Crowther. Pp. xviii + 376 with plates. London : Kegan Paul, Trench, Trubner and Company. 1931. Price 12s. 6d.

Much attention has recently been given to popular expositions of astronomical and astrophysical phenomena and these have been considered as the "Marvels of the Universe" to the exclusion of chemical and biological phenomena which can claim equally a place in any survey of the natural universe. As Mr. Crowther rightly insists, the word "universe" is to-day being used freely but loosely. Many people have no clear idea of what they mean when they refer to it. The author has therefore attempted a broadening of our outlook by discussing the general natural of the giant (finite perhaps) universe. He then goes on to consider the island universe containing the stars, the sun and the earth. From this he goes on to a consideration of the ultimate materials of the earth and to a discussion of the electron, the proton and radiation—at the other end of the universal scale so far as magnitude is concerned. The phenomena of radioactivity and their correlation with other means of probing the structure of the atom are dealt with in a lucid manner.

From this, Mr. Crowther turns to biological matters, discussing the perpetuation of life and kind, reproduction, heredity and evolution. He deals with the organism as a whole and the special functions of the separate organs, ending with the brain and its activities. He has endeavoured to arrange the vast array of facts and material so that the whole ontline of the universe is presented in proper perspective. Technicalities have been avoided so that readers specialising in one branch of science may read with interest and advantage the chapters on subjects with which they are not so familiar. It is to be hoped, also, that non-scientific readers will be encouraged to read Mr. Crowther's very inclusive exposition of the varied phenomena of science.

We have received No. 46 of W. G. Clifford and Son's (Huntingdon), "Old Book Bulletin," announcing old volumes for sale. Among these are a number of scientific interest including a copy of *The Principles of the Chymists of London Stated* (1676) which is offered for £2 5s.

Forthcoming Events.

FRIDAY, MAY 22.

Royal Institution, 21, Albemarle Street, W.1., at 9 p.m. "X-Ray Investigations of the Structure of Liquids," by Sir William Bragg, K.B.E., M.A., D.Sc., F.R.S., M.R.I.

WEDNESDAY, MAY 27.

S.C.I. Broadcast Talk, National B.B.C. Programme. "Chemistry and the Housewife," by Dr. Margaret Fishenden.

MAY 27-29.

Canadian Chemical Convention, Montreal, Quebec.

FRIDAY ,MAY 29.

Royal Institution, 21, Albemarle Street, W.1., at 9 p.m. "The Future of the Human Race," by Very Rev. W. R. Inge, K.C.V.O., D.D., LL.D.

THURSDAY, JUNE 4.

Chemical Society, Burlington House, Piccadilly, W., at 8 p.m. Ordinary Scientific Meeting.

Canadian Gas Association. Annual Meeting, Windsor Hotel, Montreal.

Royal Society of Arts, John Street, Adelphi, W.C.2., at 6 p.m. "A New Form of Prime Mover and Its Uses for Locomotives, Marine, and other Engines," by J. F. J. Malone.

FRIDAY, JUNE 5.

Royal Society of Arts, John Street, Adelphi, W.C.2., at 4.30 p.m. "The Indian Paradise Garden," by Mrs. Patrick Villiers-Stuart.

Physical Society, Imperial College of Science, South Kensington, S.W.7., at 5 p.m.

Royal Institution, 21, Albemarle Street, W.1., at 9 p.m. "Habit—the Driving Force in Evolution," by E. W. MacBride, M.A., D.Sc., LL.D., F.R.S.

WEDNESDAY, JUNE 10.

Faraday Society. Annual General Meeting. Burlington House, Piccadilly, W., at 8 p.m. "Laboratory Study of the Atmospheric Corrosion of Metals. Part I. The Corrosion of Copper in Certain Synthetic Atmospheres, with particular Reference to the Influence of Sulphur Dioxide in Air of Various Relative Humidities," by Dr. W. H. J. Vernon. "An Air Thermostat for

Quantitative Laboratory Work," by Dr. W. H. J. Vernon. "Quantitative Humidification of Air in Laboratory Experiments," by Dr. W. H. J. Vernon and L. Whitby.

THURSDAY, JUNE 11.

OPTICAL SOCIETY. Ordinary Meeting. Imperial College of Science, S.W.7., at 7.30 p.m.

WEDNESDAY, JUNE 17.

FARADAY SOCIETY. Royal Institution, Albemarle Street, W.1. Spiers' Memorial *Lecture. "Michael Faraday," by Dr. R.* L. Mond.

SOCIETY OF GLASS TECHNOLOGY. Sheffield at 2 p.m.

FRIDAY, JUNE 19.

PHYSICAL SOCIETY, Imperial College of Science, South Kensington, S.W.7., at 5 p.m.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

12,525.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of hydroxymethylbenzimidazol-arsonic acids. April 28.

12,777.—I. G. Farbenindustrie Akt-Ges. —Manufacture of hydroxybenzo-carbazoles. April 30.

Specifications Published.

347,171.—Newport Co. — Preparing 3'-amino-6'-halogen benzylortho benzoic acids and substitution products and derivatives thereof.

347,137.—I. G. Farbenindustrie Akt-Ges. —Process for the manufacture of chlorine compounds.

347,323.—Holzverkohlungs-Industrie Akt.-Ges.—Process for the manufacture of acetic acid from acetaldehyde.

Abstract Published.

342,684.—Acridines. Naugatuck Chemical Co., Elm Street, Naugatuck, Connecticut, U.S.A. — Assignees of Howland, L.H.; 6, Meade Avenue, Passaic, New Jersey, U.S.A.

Meso-substituted acridines are prepared by reacting a diarylamine having at least one free *o*-position in each aryl residue, with a carboxylic acid other than formic acid, in the presence of a dehydrating agent. Suitable amines are diphenyl-, phenyl-α-naphthyl-, phenyl-β-naphthyl-, and di-naphthyl-amines; while acids specified are acetic, butyric, isobutyric, palmitic, stearic, phenyl-acetic, salicylic acids, their anhydrides or acid chlorides. An example is given of the preparation of methyl acridine, using zinc chloride as the dehydrating agent.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

METSOL.

521,449.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes.—Rushworth, Wilmore and Co., Victoria Park Mills, Hard Ings Lane, Keighley, Yorkshire. May 6.

VERICHROME.

520,355.—Photographic chemicals.—Kodak, Ltd., Kodak House, Kingsway, London, W.C.2. May 6.

CONFESSIONS OF GREAT SOULS.

By the Rev. J. E. Roscoe, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

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THE DETECTION OF THE CHLORIDE GROUP ACIDS IN THE PRESENCE OF THIOSULPHATE.

By L. J. CURTMAN AND S. M. EDMONDS.

(Contribution from the Laboratory of Qualitative Analysis, College of the City of New York.)

The preliminary test for the acids of the chloride group comprising the anions Cl', Br', I', CN', CNS', $Fe(CN)_6'''$, $Fe(CN)''''$, and S'' is based on the insolubility of their silver salts in 10 per cent. nitric acid solution[1]. The presence of the thiosulphate ion, however, seriously interferes with this simple and valuable test by yielding with silver nitrate a white precipitate of silver thiosulphate which rapidly turns yellow, then orange and finally black, the last being due to the formation of Ag_2S. As little as 1 mg. of S_2O_3'' in a volume of 50 cc. suffices to give a brownish-black precipitate under the conditions of the chloride group test.

In searching for a method for overcoming this difficulty, the effect of numerous precipitants and oxidants on S_2O_3'' was studied. Not only silver, but certain other metals, notably mercury and copper, are precipitated as the sulphides by thiosulphate in acid solution. However, only with Hg^+ and Hg^{++} was the removal of thiosulphate complete. Unfortunately, both these ions form very stable complexes or insoluble compounds with certain of the acids to be tested for.

Of the several oxidants that were studied, sodium peroxide proved to be the only one capable of oxidising S_2O_3'' without destroying any of the acids to be tested for.[2] A method based upon this fact was worked out and used for some time in this laboratory, but was found inadequate when applied to certain complex mixtures containing copper or cobalt salts together with tartrate. In the course of the acid analysis, the heavy metals are first removed by boiling the sample with sodium carbonate solution. Certain metal ions, notably Cu^{++}, Co^{++}, Fe^{+++} and Cr^{+++}, when present along with certain organic acids such as $C_4H_4O_6''$, are not completely removed by this treatment since they form soluble, highly coloured complexes. Extended investigation showed that the oxidation of S_2O_3'' to SO_4'' by sodium peroxide was in-

[1] Curtman and Plechner, *Chem. News*, 1929, *138*, 65.
[2] CN'' and CNS'' in amounts less than 5 mg. in 50 cc. are completely oxidised.

hibited to a very large extent by extremely small amounts of cobalt. Copper, ferric iron and manganese were also found to display this ability to a very pronounced, and chromium and nickel to a lesser, extent. This inhibition is decidedly catalytic since it was found that very small amounts of these metal ions prevented the complete oxidation of thiosulphate even when a very large excess of peroxide was used. It was further found that the decomposition of sodium peroxide in alkaline solution was very greatly accelerated by the presence of small quantities of these metal ions.[3] The addition of 0.1 mg. of Co^{++}, for example, to a cold solution of sodium peroxide causes an almost immediate vigorous evolution of oxygen. By virtue of their ability to form complex ions, Cu^{++}, Fe^{+++}, Cr^{+++} and Co^{++} may pass into the sodium carbonate solution in quantities sufficient to prevent the subsequent oxidation of thiosulphate by sodium peroxide. It was necessary, therefore, to abandon this method.

Experiments showed that potassium permanganate in dilute sulphuric acid solution very readily oxidises both silver thiosulphate and silver sulphide to silver sulphate but only very slowly affects the silver salts of the acids of the chloride group. This fact was utilised in developing the following procedure for the detection of the chloride group acids in the presence of thiosulphate.

Procedure.

To 3 cc. of prepared solution (Note 1) add 15 cc. of $N/4$ $AgNO_3$. Stir and add immediately 25 cc. of N $KMnO_4$. Acidify the solution with $3N$ sulphuric acid and add 5 cc. in excess. Stir from time to time and allow the mixture to stand for five minutes. (Note 2). Add, with stirring, small portions of powdered sodium nitrite until all the brown MnO_2 has dissolved and a small white precipitate of silver nitrite remains. Add 5 cc. of conc. nitric acid and heat to boiling with constant stirring. A precipitate indicates the presence of one or more of the following acids : Cl', Br', I', $Fe(CN)_6'''$, $Fe(CN)''''$, CNS' and CN' (Note 3).

Notes.

(1) This solution is obtained by treating 3 g. of the substance to be analysed with 50 cc. of $3N$ sodium carbonate solution, boiling for three minutes and filtering.

(2) Since AgCNS, AgCN and to a lesser extent AgI are appreciably oxidised on prolonged standing, care should be taken not to exceed this time limit.

(3) The minimum amounts of these acids detectable by means of the procedure when the test is compared with that obtained with a control are as follows : 1 mg. of Cl', Br', $Fe(CN)_6'''$ and $Fe(CN)_6''''$; 2 mg. of I'; 5 mg. of CN' and 10 mg. of CNS'.

Test Analyses.

To test the procedure, solutions were analysed, containing in 3 cc.[4] of $3N$ sodium carbonate solution, 150 mg. of thiosulphate and 1 mg. respectively of each of the following acids : Cl', Br', $Fe(CN)_6$, and $Fe(CN)_6''''$. In all cases a decided precipitate was obtained. Controls containing 150 mg. of S_2O_3'' in 3 cc. of $3N$ sodium carbonate gave final solutions which were very slightly cloudy. With 2 mg. of I' under the same conditions a precipitate was finally obtained, although with smaller amounts the results were doubtful. Cyanide and thiocyanate appear to be partially oxidised. The limits of sensitivity for these anions were found to be 5 mg. of CN' and 10 mg. of CNS'.

Summary.

The preliminary test for the acids of the chloride group, depending upon the precipitation of the silver salts of these anions in 10 per cent. nitric acid solution, cannot be applied in the presence of thiosulphate.

Sodium peroxide in alkaline solution oxidises thiosulphate to sulphate. This reaction, however, is almost completely inhibited by very small amounts of copper, ferric iron, cobalt and chromium, often present along with tartrate and certain other anions in the sodium carbonate "prepared" solution.

In cold acid solution, permanganate completely oxidises both $Ag_2S_2O_3$ and Ag_2S to Ag_2SO_4. Under the same conditions, the silver salts of the acids of the chloride group are not appreciably affected.

Based upon this fact, a method has been devised for the detection of the acids of the chloride group in the presence of thiosulphate.

[3] Bredig and von Berneck, *Z. physik. Chem.*, *1899* *31*, *258*; *1901*, *37*, 1, have shown that MnO_2, Co_2O_3, CuO and PbO_2 when suspended in water have a similar catalytic effect on alkali peroxide.

[4] Assuming that 50 per cent. of the sample consists of the acid radical, then the maximum quantity of any one anion in 3 cc. of this solution will be 90 mg.

DENSITIES OF MOLTEN CRYOLITE AND OF MOLTEN MIXTURE OF CRYOLITE AND BARIUM FLUORIDE.

By NAOTO KAMEYAMA AND ATSUSHI NAKA.

This determination consists of a part of the investigation of the electrolytic bath to be used for the electrolytic refining of aluminium by the three layer method such as F. C. Frary reported. In this method, the molten aluminium cathode should float on the top of the bath, and the anode consisting of the molten mixture of aluminium, copper and silicon should sink to the bottom of the bath. The density of the bath should line between that of cathode and that of the anode. Therefore this determination was undertaken. The melting point of cryolite -- barium fluoride was reported in the previous paper.

The density was determined by the buoyancy method. A small weight made of platinum was suspended in the molten salt by a long fine platinum wire from one arm of the chemical balance which was modified by T. Somiya for the purpose of the accurate weighing at high temperatures.

The fused salt was kept in a platinum crucible. The temperature was measured by a thermo-couple which was immersed bare in the fused salt. The expansion coefficient of the platinum weight was determined by its buoyancy in water and molten chloride of potassium.

The results are given below, the figures are those already corrected for the sublimed quantity, etc.

Composition of the salt:					
Quantity of BaF_2 in the melt—					
in weight percentage	0	21.8	50.0	62.5	71.6
in molar percentage	0	25.0	54.4	66.6	75.1
Density in g/cc.					
952°	—	—	2.99	3.29	—
975°	—	—	—	—	3.79
1005°	—	2.41	2.94	3.23	3.77
1035°	2.04	—	—	—	—
1057°	—	2.37	2.91	3.18	3.73
1079°	2.01	—	—	—	—
1093°	—	2.34	—	—	—
1122°	1.97	—	—	—	—

As cryolite is liable to decompose at high temperatures, as much care as possible was paid for avoidance of heating at too high a temperature and for an unnecessary long duration.

It became quite certain that the density of cryolite decreases as the temperature increases. This is contrary to the result of Pascal and Jouniaux. According to them, the density of molten cryolite show a maximnm at 995°. According to our results, there is no such maximum, nor does cryolite melt below 1000°. Density of the molten mixture of cryolite and barium fluoride behave similarly, it decreases as the temperature increases. Interpolated from the result, we have the following at 1050°.

Composition of the melt:					
Content of BaF_2 in the melt—					
in weight percentage	0	21.8	50.0	62.5	71.6
in molar percentage	0	25.0	54.4	66.6	75.1
Density g/cc	2.03	2.37	2.91	3.19	3.74
Specific volume cc/g ...	0.49	0.42	0.34	0.32	0.27
Molecular volume cc/g mol	103	84.8	65.8	58.7	49.3

In conclusion, such densities as are necessary for the electrolytic refining of aluminium by the three layer method at high temperatures can be had by the suitable mixture of cryolite and barium-fluoride.

Department of Applied Chemistry,
Tokyo Imperial University.

PHYSICS IN RELATION TO THE *DEVELOPMENT OF THE INTERNAL* COMBUSTION ENGINE.

Lecture delivered by ALAN E. L. CHORLTON, M.Inst.C.E., before the Instiute of Physics on Tuesday, 19th May, 1931.

The development of all internal combustion engines using gas or oil as a fuel and for all duties whether stationary on land, or for transport, road, marine or in the air, owes more to the guidance of Physics than any other prime mover.

In the first period, when the engine was nearly always a gas engine, the investigation of the processes which governed its action and the limitation of its cycle of working were carried out by Physicists like Sir Dugald Clerk, Professor Hopkinson, and others. The results assisted and accelerated development making possible the extended use of the engine for all industrial purposes that followed.

Perhaps the outstanding feature during this time was the growth of the engine in size until ultimately engines using the gases from blast furnaces were built, or are building, for powers as large as 10,000 H.P. per engine. These large size engines are found usually abroad operating in the most efficient iron and steel works.

In the smaller sizes in this country a far greater extent of usage would have taken place if the Gas Industry had had more vision and seen the possibilities of a country wide gas supply with interconnecting trunk mains as has been done since by the Electrical Industry.

The War period followed, and led to an intensive and rapid development in the engine for transport, in particular in the air, where special materials and increased accuracy of workmanship were called for.

The extraordinary progress made was largely due to the number of highly trained physicists and engineers who concentrated upon every problem and solved it as it arose.

Since the War, development has been in the use of oil and the wide adoption of the engine for marine propulsion has been due to the economy of the Diesel motor. The high economic possibilities of this engine were thoroughly discussed in a paper by Diesel before the engine was actually built, and it took many years to bring this into practice, the results have justified all that he had proposed.

At the present time, development is being concentrated upon the high speed oil motor using relatively cheap fuel with the added advantage of reducing the risk of fire, for road transport and for the air, and very good progress is being made.

The first safety first engines to fly regularly were those supplied to the Airship R.101. Since then one has flown in America and one in Germany, and these will shortly be followed by another type in this country.

On the road, most extraordinary progress has taken place in the application of the small engine to motor lorries, etc., the economy with cheaper fuel and using less of it has been so marked.

This class of engine has called for the most intensive investigation and research that has ever been carried out in the internal combustion engine world. Much valuable laboratory work has been carried out in America by the National Advisory Committee for Aeronautics in connection with their Air work; some also in this country ,and some abroad.

This reveals the intensity of effort which will before long ensure that not only will the oil engine become predominant for road work of heavier nature, but also for the air, where its great safety from the fire risk coupled with its economy makes it so highly suitable.

The use of coal dust in the engine progresses very slowly for a country like ours, whose industrial supremacy is founded on coal. This is to be regretted, and we should conduct special work with this object.

In all the development of the engine, the steady improvement of the material has been the measure of the progress made. To-day we have new steels practically unwearable, allowing high speeds and long life, and also of such strength that motors like the Schneider Cup engine weight less than 1 lb. per h.p. and a degree of excellence of workmanship not excelled, if equalled, in all the world.

BENZENE FROM TURNER VALLEY GAS.

In a recent statement before the Alberta Legislature the Premier intimated that the Provincial Government would build a semi-commercial plant at Calgary this year in order to test an experimental process for the extraction of benzene from the waste gas of the Turner Valley. The action of the Government has been determined upon following a series of highly successful experiments by Dr. E. H. Boomer of the University of Alberta .

PROF. EINSTEIN AT OXFORD.

SECOND RHODES LECTURE.

THE FINITE UNIVERSE.

Prof. Einstein, the distinguished physicist, delivered two of his lectures on the problem of the finite universe on May 9 and 16.

He began by imagining a three-dimensional sphere large enough to contain many stars about any point in the universe and dividing the enclosed mass by the volume of the sphere one obtains a mean density, ρ, which may be assumed to reach a limiting value as the radius increases. It is to be assumed that this value is not zero, since otherwise the universe would be virtually empty.

It is natural to assume that this density ρ is the same everywhere in the universe. The question arises : Are the field equations of the general theory of relativity compatible with this assumption

For a preliminary investigation one can imagine the local irregularities smoothed out and replace ρ by a density constant throughout the universe. In this way space with irregular local curvatures is replaced by one of constant curvature.

On first approaching this problem I made the further assumption that the density thus defined (and consequently the constitution of space on a large scale) did not change with time.

Calculations show that the field equations of the general theory of relativity cannot be solved with these assumptions throughout a space of constant curvature. But it appeared that a solution was possible if an arbitrary term (the λ term) was added to the field equations, a procedure compatible with the general relativity postulate. A spherical space resulted whose radius P was defined uniquely by the density $[P_\infty(\kappa\rho)^{-\frac{1}{2}}]$, where κ denotes the gravitation constant of the general theory of relativity.

In 1922 A. Friedmann discovered that these equations (with λ term) also have solutions in which P and ρ are functions of the time. De Sitter, Lemaitre, and Tolman also investigated these problems mathematically. The question has entered a new phase, since Hubble has shown in the course of the last few years by spectral investigation of the extra galactic nebulæ that these show a Doppler effect (displacement towards the red of spectral lines), increasing linearly with the distance, and that these systems (each analogous to the Milky Way) are distributed approximately uniformly in space. If these red displacements are to be interpreted as radial motions, an interpretation we have at present no right to call into question, then the assumption that ρ does not vary with the time is considerably weakened.

Basing ourselves on Friedmann's formulæ it may be shown that the equations of the general theory of relativity can be satisfied by an expanding space, and, what is more, without introducing the λ term, which was theoretically unsatisfactory and empirically uncalled for. According to this the order of magnitude of the varying world radius depends not only on the mean density ρ, but also upon Hubble's constant for the red displacement

$$\left(D = \frac{\textit{Doppler effect}}{\text{distance}}\right)$$

according to the equations

$$P_\infty(\kappa\rho)^{-\frac{1}{2}};\ P_\infty\frac{1}{D}$$

But we cannot ignore certain difficulties : The small value of the world radius (10^8 light years); the comparatively short period during which the space structure can have been expanding (10^{10} years); and the difficulty of extrapolating in time farther back into the past.

TENDERS FOR ZINC WHITE AND LEAD MINIUM.

ROUMANIA.

The Commercial Secretary to H.M. Legation at Bucharest reports that the "Regie Autonome P.C.A." (Directia Serviciului Hidraulic), is calling for tenders to be presented in Bucharest by the 3 June for the supply of :—

4,500 kilogrammes zinc-white.

5,000 kilogrammes lead minium.

Firms desirous of offering zinc-white and lead minium of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X 7069 should be quoted.

DIFFERENCE IN FORCE OF GRAVITY

A body weighing one pound at the earth's surface would weigh 27 pounds at the surface of the sun.

SUPPORTS FOR NICKEL CATALYSTS.

When used as a catalyst in the hydrogenation of oils, the activity of nickel may be enhanced by distributing the finely divided metal over large surfaces of inert materials, *e.g.*, asbestos, pumice, Kieselguhr and compounds of the earth and rare earths. In order to elucidate further the much debated question of whether such promotors act merely mechanically, by increasing the surface of the catalyst, or whether they exert an additional specific catalytic effect, an extensive investigation has recently been made on the activity of nickel catalysts (nickel precipitated as nickel carbonate), distributed on various support materials. Some 70 catalysts were used, and conditions of preparation were controlled to produce strictly comparable results. The experiments were made with uniform samples of sotton seed oil, and similar (check) tests were conducted with other soils. The authors draw the following conclusions :—

The activity of nickel is completely inhibited by (1) reducible heavy metal oxides, and (2) salts of those metals which decompose on heating in a stream of hydrogen. Substances having corrosive properties retard, but do not completely inhibit, activity; the more inert the support is towards nickel, the greater is its tendency to enhance activity, and *vice versa*. The oxides of silicon, aluminium, chromium, manganese, titanium, cerium, uranium and magnesium, and the phosphates and borates of aluminium, chromium, manganese, cerium, uranium, magnesium, calcium, strontium, barium and lithium are found to exert a highly beneficial effect as supports for nickel.

STARTED BY CARTIER IN 1534.

The work of measuring the real direction of the magnetic needle at different places in Canada is an incidental in the activities of the Topographical Survey, Department of the Interior, Canada. This work was started by Jacques Cartier in the gulf of St. Lawrence in 1534, and continued by Sir Francis Drake on the Pacific coast in 1579, Master John Davis in Davis Strait in 1585, Captain William Baffin in Baffin island in 1615, Captain Cook and Captain Vancouver on the Pacific coast in 1778 and 1792, and Sir John Franklin in the interior in 1819.

THE AMERICAN CHEMICAL INDUSTRIES.

The United States was occupied chiefly before the war in the manufacture of basic chemicals, thus leaving the country heavily dependent on foreign sources for the supply of advanced commodities, since then American chemical iudustries have made vast strides. With the assistance of very large and highly concentrated capital resources, the most up-to-date organisation and equipment, practically unlimited funds for research and high tariffs to keep the rich domestic market secure against invasions from outside, the varied group of manufacturing chemical firms have so enlarged and developed their activities in fifteen years that the United States has already taken first place as a producers of chemicals and allied products and is second only to Germany as an exporter. The chemical manufacturers provide employment for over 260,000 workers and their payrolls in 1927 aggregated 311 million dollars. Through mergers and re-investment of earnings, the larger concerns have attained great financial strength, and although there is no single dominant concern in the industry it is believed that the combined assets of the three leading producers are twice as great as those of the strongest European organisation.

The trend towards concentration of resources and enlargement of capacities of the principal firms show no sign of slackening up to the present, the merger movement on the contrary, appears to have been somewhat quickened by the necessity of overcoming inter-commodity competition and adjusting output to demand in a period of general recession. Within eighteen months or so the Union Carbide and Carbon Corporation, a holding company manufacturing through about fifty subsidiaries a widely diversified line of chemical and metallurgical products, secured control over the Colorado Compressed Gas Company, the United States Vanadium Corporation and the Meraker Smelting Company, Ltd., of Norway. In the same period the Du pont Company took over the Krebs Pigment and Chemical Company, the Roessler and Hasslacher Chemical Company and others; the American Cyanamid Company a large manufacturing firm of very recent growth, acquired the Calco Chemical Companw, with eight subsidiaries; Monsanto Chemical Works absorbed five previously

independent firms, the Air Reduction Company, Incorporated. controlling nearly 100 plants throughout the United States are holding a large minority interest in the United Industrial Alcohol; acquired the Magnolia Airco Gas Products Company of Texas, thereby increasing its outlets in the pipe line field; Commercial Solvents Corporation, leading producers of butanol, acetone, syntheticmethanol, ethyl alcohol, acetic acid and numerous by-products, took over Commercial Pigments Corporation, manufacturer of titanium dioxide; American Solvents and Chemical Corporation by obtaining control of Rossville Commercial Alcohol Corporation and General Industrial Alcohol Corporation, became the second largest producers of industrial alcohol. These examples show how general and active the merger movement is, and there is every reason to believe it will continue, strengthening the competitive or bargaining position of the largest units both at home and abroad. Several of the large American chemical manufacturers maintain relationships and understandings with European and Canadian producers or operate factories in Europe and Canada, so that there exists a certain interlocking of international interests that make the statistics of trade movements difficult to interpret in terms of international competition.

Because of the wide variety and diverse uses of its numerous products, the American chemical industry in general suffered less last year from the depression than the majority of other industries. Analyses of commercial returns show that the total profits of the thirteen leading chemical companies during the first nine months of 1930, though they were over 18 per cent. less than the corresponding 1929 period, were nearly 5 per cent. larger than the like period of 1928, while corporate earnings as a whole declined by 35 per cent. and 19 per cent. respectively from the two periods mentioned. The experiences of 1930 were, however, very unevenly divided and the year in the United States was marked by severe inter-commodity competition due to the development of new products and improved processes. Cheap synthetic methanol for instance, made heavy inroads on the market for wood-distillation products. In the alkali field, lime has become a severe competitor with caustic soda and chlorine, and the position of caustic soda is being further threatened by synthetic ammonia, borax, tri-sodium phosphate, and others. Among the nitrogen carriers, comparative price advantages are diverting attention, particularly that of fertiliser manufacturers, to by-product ammonium sulphate, urea and synthetics. In 1930 for example the price of by-product ammonium sulphate was quoted at \$35 a ton, or \$1.70 per unit of nitrogen, as against 39 dollars a ton ex-vessel on sodium nitrite, or \$2.50 per unit of nitrogen. Even by-product ammonia is threatened by cheaper synthetic nitrogen products, and competition in this whole field will be intensified if the present programme of increased production of synthetic products should be successfully carried out. Imports of sodium nitrate during the ten months ending last October dropped to 497,000 tons from the figure for the corresponding period of 1929, when when they totalled 822,000 tons.

Sulphuric acid is facing some competition in the fertiliser industry from nitric acid and phosphoric acids and some reduction in demand by reason of changing industrial processes in petroleum refining and other fields. Amonst the raw materials required for its manufacture, the pure sulphur deposits of Texas have now grown to be by far the most important source, contributing 1,071,100 short tons of sulphur in 1930 as compared with 716,800 short tons of pyrites. By-product gases accounted in 1930 for 750,000 of acid and promise to increase their competition. Between pure sulphur and by-product gases, pyrites appear to be losing ground, the market now being practically restricted to points near the seaboard where cheap ocean hauls give imported pyrites a considerable price advantage.

Potash production in California is being expanded and commands the market in its immediate neighbourhood, the demand in the remainder of the country being meet as hitherto from European sources, but the recently discovered polyhalite deposits in Texas are being energetically explored and the departments in Washington concerned with the development have hopes that their exploitation may render the United States self-sufficient in this important material.

CANADA'S HYDRAULIC INSTALLATION.

Almost five and one-quarter million horse-power or over 85 per cent. of Canada's hydraulic installation is developed by central electric station organisations for the sale of electricity to the public, according to the Dominion Water Power and Hydrometric Bureau of the Department of the Interior.

GENERAL NOTES

SAFETY IN THE CHEMICAL INDUSTRY.

The first Chemical Session that has ever been held in this country in connection with the Safety Movement, took place at Leeds on Tuesday, 12 May, as the first item on the programme of the National Safety First Week arranged by the National "Safety First" Association. The Chemical Session was organised by the Association of British Chemical manufacturers, the Chairman of which, Dr. E. F. Armstrong, presided at the meeting. The subject of the discussion was that of the Cleaning and Repair of Plant and Vessels containing Dangerous Materials, a subject of the greatest importance not only to the Chemical Industry but also to industry as a whole, since this problem in one form or another presents itself to practically every type of industrial activity. Furthermore, numerous casualties, many of them fatal, have occurred in the past owing to neglect of the proper precautions and safety measures.

In his introductory remarks the Chairman referred to the active part played by the Association of British Chemical Manufacturers in promoting the cause of safety in the Chemical Industry and to the publication of its Model Safety Rules, defining, explaining and illustrating the principles to be observed in the manufacture and handling of various types of dangerous materials. The Association also provides a regular service to its members by its Safety Circulars dealing with accidents from which useful lessons may be drawn, and by its quarterly Summary of technical information on all matters likely to be of assistance in promoting the cause of safety. These services can be secured by non-members on terms that can he ascertained, by application to the Association.

The subject of the meeting was introduced by Mr. J. Davidson Pratt, General Manager of the Association, in a concise and comprehensive survey of the principles to be observed in the cleaning and repair of plant and vessels, construed in the widest sense, which have contained dangerous materials of any sort. After indicating the main general precau- gassing and corrosive risks, the speaker enunciated the three practical considerations which must be applied in rendering a vessel safe for repair purposes, namely, (i) the isolation of the vessel from every source of dangerous material, (ii) the thorough removal of the dangerous material by appropriate methods of cleaning, and (iii) a final inspection and certification by a responsible person to ensure that the vessel is free from danger. The need for each of these steps and their general application was explained with reference to various types of plant and vessels generally encountered in industry. Special emphasis was laid on the importance of bearing the cleaning and repairing problem fully in mind in designing and laying out the plant, so that these essential operations can be conducted with the greatest simplicity, efficiency and safety, while the need for the education of all the operatives in the risks involved and the precautions to be taken was stressed. In conclusion a plea was made for the fullest co-operation of all concerned in a works in order that the necessary precautions are fully understood and loyally carried out.

Mr. H. C. Dungey of the Yorkshire Tar Distillers, Ltd., opened the discussion with a detailed explanation of the procedure employed in connection with tar stills in which emphasis was laid on the value of top and bottom manholes in all vessels which men were required to enter. He was followed by Mr. G. B. Jones, Works Manager of the Dalton Works of Imperial Chemical Industries, Ltd., at Huddersfield, who dealt with the practical measures observed in the dyestuffs industry where a wide range of materials is involved. Particular mention was made of the value of using mice as a test for gassing risks, and of the importance of design in facilitating easy and safe repair. It was emphasised that carefully organised safety methods need not cause delay or increase the cost of the factory.

Mr. D. Crockatt of John Crockatt, Ltd., Dyers and Dry Cleaners, dealt with the special problems of the dry cleaning industry which arise from the inflammable and toxic nature of the spirit used, and advocated the use of white spirit as a means of reducing these risks.

Dr. J. A. Lloyd of Courtaulds, Ltd., dealt with the problems of the artificial silk industry, with special reference to acids and carbon bisulphide. The dangers arising from the admixture of the various effluents other than in the effluent disposal plant were stressed and examples were given of casualties arising from this cause. The varied problems with which the Billing-

ham Factory of Imperial Chemical Industries, Ltd., has to deal were briefly explained by Mr. Woods, the Billingham Safety Officer, and special attention was drawn to the methods to be used in dealing with high pressure which presents a number of problems not normally encountered in the rest of the Chemical Industry.

Mr. L. C. McNair, His Majesty's Engineering Inspector, Factories Department of the Home Office, dealt with various problems of the type under discussion arising in connection with blast furnaces, acetylene generators, gas holders, ships' oil tanks and the ordinary motor car petrol tanks, and concluded by a brief description of the equipment and functions of the Home Office Industrial Museum in Horseferry Road in promoting the cause of safety.

The Chairman, in summing up, thanked the various speakers for their valuable contributions and stressed the importance of the widest press publicity being given to the useful and practical information which had been communicated to the meeting. The Session terminated by a vote of thanks to the Chairman proposed by Mr. Stevenson Tyalor, one of His Majesty's Inspectors of Factories, in which he paid tribute to the invaluable work which the Association of British Chemical Manufacturers is doing in furthering the cause of safety in the Chemical Industry.

CONCENTRATOR FOR ALDERMAC MINE.

SULPHUR PRODUCTION TO BE UNDERTAKEN.

The Directors of Aldermac Mines, Ltd., have decided to proceed almost immediately with the erection of a 500-ton flotation concentrator, and the mine will probably be brought into production next autumn. Large quantities of pyrites are likely to be marketed for the production of sulphur by the new " Freeman " process .

The Aldermac ore consists of between 60 and 70 per cent. pyrites containing about 2 per cent. copper. On the basis of the proposed operations, the mine is expected to produce about 6,000,000 pounds of copper annually, concentrates being delivered to the Noranda smelter where blister copper will be produced.

The recovery of sulphur will be effected by the process developed by Mr. H. Freeman, for which the inventor received the Randolph Bruce medal at the recent Annual Meeting of the Canadian Institute of Mining and Metallurgy. By this process, sulphur dioxide gas will be produced for the manufacture of the sulphite cooking liquor used in paper mills producing chemical pulp. The " Freeman " equipment for the flash roasting of sulphide ores is installed in the paper mills, and the operation of producing the sulphur-dioxide is developed to a point at which the manufacture of the cooking liquor is as simple as the present manner in which sulphur is used.

THE " FREEMAN " PYRITE BURNER.

The " Freeman " process has been in continuous operation in one of the mills of the Canadian Power and Paper Corporation, and besides the important factor of utilisation of a Canadian source, of sulphur, large economies are claimed for the paper-making industry over the use of imported sulphur. The process not only produces the sulphur dioxide gas required but provides heat for steam production, which is a direct saving, and iron oxide as a by-product for use in the production of iron and steel. The pyrite preferred for the process is flotation pyrite containing fifty per cent. or more of sulphur and the Aldermac concentrator, it is understood, will be designed to produce such a product.

The general introduction of pyrite into Canadian paper mills has been calculated to afford a saving of $1,925,000 annually. In arriving at this figure the cost of imported sulphur is placed at $4,000,000 and of pyrite which would take its place at $2,375,000, a saving of $1,625,000 on material, besides which $150,000 is calculated as the savings or steam at some of the mills and $150,000 as the revenue to be derived from the by-product iron oxide. There would also be increased expenditures in Canada calculated at $600,000 for extra freight in pyrite, $150,000 for freight on iron oxide and $850,000 for labour and material at mines, a total in labour freight and material of benefit to Canadian industry amounting to $1,600,000.

In connection with the decision to place the Aldermac mine in production and to market the pyrites, it is stated that the Sulphite Research Corporation, Limited, is planning to install the " Freeman " roasting equipment in any of the paper mills in Eastern Canada without capital cost to the paper companies.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

May 21.

Stereoisomerism of Disulphoxides and Related Substances. Part VII. Some Further Pairs of Isomeric Dioxides. By G. M. BENNETT AND F. S. STATHAM.

The oxidation of four further aromatic disulphides has yielded pairs of dioxides, and the dioxide of ethylenedithioldiacetic acid (*Ber*, 1914, XLVII, 730) is also shown to be a mixture of two stereoisomerides. A second isomeride could not be detected when diethylthiolethane and 1 : 3-dithiolan were oxidised. Four new bis-sulphilimines of disulphides are each apparently homogeneous.

Part VIII. Isomeric Tetrabromides of a Disulphide.

The two forms of the tetrabromide of 1 : 4-dimethylthiolbenzene previously described as dimorphous (*Ber.*, 1909, XLII, 2721) are shown to be isomeric. The view that these are stereoisomerides is supported by observations on their conversion into, and regeneration from, the two dioxides described previously. The formulation of the sulphide-dibromide grouping is considered in the light of this result.

Studies in the Penthian Series. Part IV. The Four Stereoisomeric Oxides of Benzoylaminobenzpenthiene. By G. M. BENNETT AND W. B. WADDINGTON.

Reduction of the oxime of thiochromanone gives aminobenzpenthiene, which has been resolved into its *d*- and *l*-forms by means of bromocamphorsulphonic acid. The two stereoisomeric sulphoxides formed by the oxidation of *d*- or *l*-benzoylaminobenzpenthienes have in each case been separated, yielding the four active forms : *d*-α, *l*-α, *d*-β, and *l*-β.

Derivatives of the Aliphatic Glycols. Part III. Chlorohydrins of Some Higher Glycols. By G. M. BENNETT AND A. N. MOSSES.

The chloroacetin of hexamethylene glycols and the chlorohydrins of hepta-, octa-, nona-, and decamethylene glycols have been prepared and used for the synthesis of the hydroxysulphides of the type $Ph.S(CH_2)_n.OH$ ($n=6$ to 10). The yields of the glycols obtained by reduction of the corresponding dicarboxylic esters have been considerably improved by attention to certain experimental details.

The Influence of the Sulphur Atom on the Reactivity of Adjacent Atoms or Groups. Part V. Comparative Reactivities of Nine Homologous Phenyl ω-Hydroxyalkyl Sulphides with Hydrobromic Acid. By G. M. BENNETT AND A. N. MOSSES.

Measurements have been made of the velocities of reaction of the hydroxysulphides $Ph.S(CH_2)_n.OH$ (where $n=2$-10) with hydrobromic acid in phenol solution. The results follow the bimolecular law, allowance being made for the reversibility of the reaction. The values of reactivity provide a quantitative confirmation of the conclusions arrived at for some of these substances in a qualitative manner in previous papers of this series; the general significance of the results is discussed.

Studies in Complex Salts. Part IV. The Effect of Alkyl Substitution on the Tendency of the Aminoacetate Ion to Co-ordinate with Copper. By H. L. RILEY AND V. GALLAFENT.

The effects of the addition of sodium aminoacetate and other aminoacetates on the copper-ion concentration in a solution of copper sulphate have been studied by a method similar to that described in Part III. The results indicate that in the presence of excess of the aminoacetate ion, the complex ion $[Cu(NH_2.CH_2.COO)_3]^-$, in which copper is displaying a co-ordination number of six, is formed. The degree of dissociation of this complex ion is not affected to any great extent by alkyl substitution on the α-carbon atom, no difference having been detected with $C_3H_7\beta$, $(CH_3)_2$ or $(C_2H_5)_2$ as substituents, and a small increase in the case of CH_3. These results are discussed in view of the different effects observed in the case of the malonate complex described in Part III.

The Electrolytic Dissociation of Transitional Metal Salts. Part I. Copper, Zinc, and Nickel Malonates. By D. J. G. IVES AND H. L. RILEY.

The preliminary study of the dissociation of the malonates of magnesium, copper, zinc, and cadmium has been extended with the view (*a*) to determine whether or not there is any relationship between the degree of dissociation of a simple salt and that of its corresponding complex anion, (*b*)

to determine the extent to which transitional metal cations control the dissociation of their salts, with the object of throwing some light on the feeble dissociation of certain salts, *e.g.*, $Hg(CN)_2$, and (*c*) to determine the extent to which small changes in the nature of the anion alter the degree of dissociation of salts of this type. Measurements have been made of the electrical conductivities of aqueous solutions of nickel malonate and the malonates, methyl-, ethyl-, propyl-, *iso*propyl-, dimethyl-, diethyl,- and dipropyl-malonates of copper and zinc, over a large range of dilution. The results are discussed from the point of view of the electronic theory and compared with earlier results of the copper-electrode potential measurements.

GEOLOGICAL SOCIETY OF LONDON.

May 6.

Prof. E. J. Garwood, M.A., Sc.D., F.R.S., President, in the chair.

The following communications were read :—

The Geology of the Country Around Mynydd Rhiw and Sarn, South-Western Lleyn (Carnarvonshire). By CHARLES ALFRED MATLEY, D.Sc., F.G.S.

The region described contains about 9 square miles of the Palæozoic country of South-Western Lleyn. It is situated between North Neigwl on the east and the Pre-Cambrian rocks of the Mona Complex on the west, and includes a ridge of high ground which stretches from Mynydd Penarfynydd in the south to Mynydd Cefnamwlch in the north, and attains a height of 994 feet on Mynydd Rhiw. Much of the lower ground is covered by glacial drift.

The sedimentary rocks are of Arenig and Lower Llanvirn age, and range from the Extensus Zone to a high part of the Bifidus Zone. The local base of the Arenig is found at only one small exposure, and there it rests on the mica-schists (Penmynydd Zone) of the Mona Complex.

In the Hirundo Zone, and extending into the Bifidus Zone, is the Rhiw Volcanic Group, in which four lava-flows have been found, as well as rhyolitic ashes and ashy sediments. The manganese-ore of Nant y Gadwen and Rhiw is a metasomatised ash, and has been taken as the base of this group. Three of the flows at Rhiw are spilitic, ranging upwards from albite-basalt to spilite. The other is a purple rhyolite. The lower lavas at Rhiw, and the one at Sarn described by Prof. O. T. Jones, have pillow structure in the basal part only, the remainder of each flow often showing good columnar structure. Comparison is made with some Merioneth lavas described by A. H. Cox and A. K. Wells, in which the same combination of structures occurs, but in which the relative position in the flows of pillow and columnar structure is reversed.

Intrusive rocks are abundant, and range in composition from acidic to ultra basic; they are linked genetically by their common richness in soda, and can be considered, with the volcanic rocks, as varied members of one spilitic suite. They include the Sarn Granite, numerous albite-dolerite sills, and the coarser-grained intrusions of picrite, proterobase, and hornblende-dolerite which are found only at the top of the sequence. These intrusions are discussed ,and the possibility considered, that they may be a single sill or laccolith broken and displaced by faulting. All the igneous rocks, extrusive and intrusive, thin out northwards.

A few albite-dolerite dykes of Palæozoic age have been found, two of which intrude into the Sarn Granite. A perlitic soda-rhyolite dyke, found near the Sarn Granite, seems to be an offshoot from it.

A correlation is made of the vulcanicity of this area with that in other parts of Wales and Shropshire. The paper also contains some remarks on the tectonics.

An Ordovician Grit from Anglesey, with its Bearings upon Palæogeography, and upon the Tectonics of the Mona Complex. By EDWARD GREENLY, D.Sc., F.G.S., AND PROF. PERCY GEORGE HAMNALL BOSWELL, D.Sc., F.R.S., F.G.S.

The grits at the base of the Arenig beds at Berw, near Holland Arms, have been found to be exceptionally rich in heavy minerals. Garnet, sphene, and epidote are wonderfully abundant, as are ilmenite, biotite, and white mica. The felspars are orthoclase, albite, and oligoclase. Tourmaline and glaucophane are absent, and only one grain of green hornblende has been seen. There are also small pebbles of Penmynydd Zone mica-schist, Gwna greenschist, and many of granitoid gneiss.

The source cannot be far distant, for the deposits are poorly graded, and the grains angular or even splintery. A source near at hand, however, can be only the Mona Complex.

The absence of tourmaline excludes at once the middle region, so the orthoclase must be traced to the augen of the Penmynydd Zone. The albite, oligoclase, garnet, sphene, ilmenite, and other minerals can only have come from the gneisses. The absence of amphiboles excludes both the basic gneisses and the basic members of the Penmynydd Zone, in spite of the proximity of those rocks to Berw. Accordingly, the evidence both of minerals aud rock-fragments points to the acid gneisses as the principal source, with contributions from the Gwna Beds and the acid members of the Penmynydd Zone.

The basic members of the Penmynydd Zone would have been, in Ordovieian time, covered by Gwna Beds; not so the basic gneisses, for they are not affected by the Gwna metamorphism. Although large masses of acid gneiss, now invisible, have been invoked, they cannot lie buried under the coalfield, for the slopes of the sub-Ordovician land all converged toward the Trewan cirque, and the slop at Berw must, therefore, have been westward. This acid gneiss must have lain higher up, and have been destroyed by waste. In that case it would provide the needed shield for the basic gneiss.

Finally, this furnishes unexpected confirmation of a tentative hypothesis, already put forward, that the gneiss of Hollaud Arms, instead of having heen brought up from below, has been brought down from above, on an infold of the Newborough slide, from the inverted upper limb of the Bododgan recumbent fold.

Specimens of Ordovician grit from Berw, Anglesey, were exhibited by Dr. Greenly, in illustration of the paper by himself and Prof. Boswell.

May 20.

The Geology of the Country between Ivybridge and Buckfastleigh, Devon. By ALBERT ALFRED FITCH, B.Sc., Ph.D., A.R.C.S., F.G.S.

The area described consists of a strip of the granite margin, the metamorphic aureole, and some rocks beyond the influence of the granite.

The physical geology is discussed, and the presence of a relic of the 700-750-foot platform demonstrated by planimetric measurements.

The Devonian is folded into a syncline, while the Culm is present only in a trough-faulted block, which appears to include a slice across the southern margin of the granite, with the Culm included at both ends, where the two faults converge. The sequence and structure are cut across by the Dartmoor Granite, and the several rock-types undergo a varied suite of changes, controlled by the degree of thermal metamorphism, of pneumatolytic and hydrothermal action, and the original lithology. The petrology and petrogenesis of the resulting rocks are discussed in detail, and some aspects of two way migration considered.

The mineral assemblage of the aureole is not of much diagnostic value for the provenance of the sediments of the Sonth of England. Superficial deposits do not afford matter of great interest.

The Secretary exhibited a series of specimens illustrating the contact-metamorphic effects of a "diabase" sill at New Hope, Bucks County, Pennsylvania.

At the meeting on June 3, the following communication will be read :—

A Contribution to the Petrology of the Metamorphic Rocks of Eastern Greenland. By JOHN DUGDALE HOLT WISEMAN, B.A. Communicatedl hy Dr. W. F. Whittard, B.Sc., A.R.C.S., F.G.S.

On the same evening, from 8.30 to 11 p.m., a Conversazione, which all Fellows are invited to attend, will be held in the Society's Rooms. The President will receive Fellows and their guests in the Reception Room (Upper Library) at 8.30 p.m. During the evening Dr. W. F. Whittard, B.Sc., A.R.C.S., F.G.S., will deliver a lecture on the "Geological Work of the Cambridge Expedition to Greenland, 1929."

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

APRIL EXAMINATIONS.

PASS LIST.

Examination in General Chemistry for the Associateship :

Bagg, Douglas Gordon (Birkbeck College, London); Berry, Wallace (Royal Technical College, Glasgow); Brown, James (Royal Technical College, Glasgow); Buckley, Robert, B.Sc. (Lond.) (Central Technical

School, Liverpool); Craimer, Harris, B.Sc. (Lond.) (Technical College, Cardiff); Edwards, Gerald Harry (University College, Leicester); Glass, Norman (Central Technical School, Liverpool); Gordon, Joseph (Rutherford Technical College, Newcastle-upon-Tyne); Leslie, Robert Edward (Heriot-Watt College, Edinburgh); Minifie, Bernard Whitley Elliott (The University(and Merchant Venturers' Technical College, Bristol); Mortou, Frank, B.Sc. (Lond.) (Wigan and District Mining and Technical College; and Technical College, Birmingham); Prescott, George Frederic Wigan & District Mining and Technical College); Sleep, William Henry, B.Sc. (Lond.) (Central Technical School, Liverpool); Stephens, Robert Charles Farquhar (Trained under G. Rudd Thompson, Esq., F.I.C.); Stroud, Hubert Henry (West Ham Municipal College; and Birkbeck College, London); Templeton, William Hugh, B.Sc. (Lond.) (Chelsea Polytechnic, London); Vizofsky, Abraham (Chelsea Polytechnic, London); Webb, William Denis Lucking (East Ham Technical College; and West Ham Municipal College).

Examination for the Fellowship:

In Branch A: Inorganic Chemistry.

Gaskin, John George Noel, B.Sc. (Lond.); Reeve, Walter William, B.Sc. (Lond.)

In Branch C: Organic Chemistry, with special reference to Oils, Fats, etc.

Elwes, Eric Vincent; Mackinney, Herbert William.

In Branch D: Biochemistry, with special reference to Industrial Microbiology:

Clayson, Donald Herbert Frank, B.Sc. (Lond.), A.R.C.S., D.I.C.

In Branch E: The Chemistry, including Microscopy, of Foods and Drugs, and of Water:

Brindle, Harry, B.Sc. (Lond.); Martin, Nicholas Henry, B.Sc. (Dun.); McGregor, Percy, B.Sc. (Lond).; Paterson, Colin, B.Sc. (Lond).

In Branch F: Agricultural Chemistry:

Greenstreet, Victor Robert, A.C.G.F.C.

In Branch G: Industrial Chemistry, with special reference to Oils, Fats, etc.:

Joseph, Douglas Eric, B.Se. (Lond.).

In the Chemistry of Textiles, etc.:

Blakeley, John Dyson, B.Sc. (Lond.); Payne, Reginald William, B.Sc. (London).

In Foods, with special reference to Chocolate and Confectionery:

Avent, Alfred George.

NOTICES OF BOOKS.

Essentials of Quantitative Analysis. By PROF. W. W. SCOTT, D.Sc. Second Edition; pp. viii+219. The Chemical Publishing Company, Easton, Pennsylvania. 1931. Price 2 dollars 75 cents.

There is undoubtedly an increasing number of students taking courses in practical chemistry and therefore textbooks dealing with both qualitative and quantitative analyses are in increasing demand. Prof. Scott's volume on *Quantitative Analysis* begins with the fundamental principles of gravimetric methods from simple estimations to the examination of mixtures. He includes a number of electrolytic processes such as the electro-deposition of copper and of lead.

The section on volumetric analysis is prefaced by detailed explanations of the principles and procedures and a general con sideration of indicators and neutralisation methods. Benzoic acid, it may be mentioned, is favoured for standardisation in acidimetry. The usual oxidation-reduction titrations with permanganate and dichromate are given, together with a number of useful applications and the same applies to the iodine-thiosulphate methods.

Finally there are numerous examples of the determination of hydrogen ion concentration (pH methods) for special purposes, including pathological cases. The examples chosen throughout have been selected on account of their offering practice along special lines—pharmaceutical, medical and industrial.

The number of exercises planned in the book are too numerous for all to be done in an ordinary course of quantitative analysis but by judicious selection the student could fare worse than at the hands of Prof. Scott.

Much of his advice and instructions should prove invaluable to students left largely to their own devices. He emphasises the necessity for careful work with a thorough knowledge of the theory underlying the operations involved and the lists of questions scattered through the text are evidently intended to stimulate observation as well as making the student conversant with chemical calculations.

Oil and Petroleum Year Book for 1931. By WALTER E. SKINNER. Pp. lx+340. London: Walter E. Skinner, 15, Dowgate Hill, E.C.4. Price 7s. 6d. Post free (Inland) 8s.; (Abroad) 8s. 6d.

The present volume of *The Oil and Petroleum Year Book* is the twenty-second annual issue, the book covers all branches of the oil industry, and is recognised as the standard international reference work on oil and allied companies operating in all parts of the world. The possession of a reliable and up-to-date reference book has become a necessity as it records the many alterations in the personnel and financial structure of British and foreign companies, and is thus invaluable to all those interested.

The many brands of oil now marketed has neissitated important additions to the list of Trade Names appearing on pages XIV and XIX and being the only list of its kind published has proved of great assistance to the trade .

Covering 450 pages it contains particulars of 620 English and Foreign Companies —Producers, Refiners, Dealers, Carriers-pipe and steamship—and oil finance companies operating in all parts of the world, including the principal American and foreign companies. Lists are also given of the officials connected with the companies and comprise 2,250 directors, 325 secretaries. and 185 consulting engineers, managers, agents, etc., their names and addresses and company connections. A useful feature is the list of 398 trade names of the petroleum products marketed by the various companies.

The particulars of each Company include the directors and other officials, date established, location of property, purchase consideration, number of wells sunk, oil production, and description of work in progress, capacity of refineries, capital, calls, dividends and financial position as disclosed by latest accounts, also highest and lowest prices of the shares for the last three years and latest price.

SUMMARY OF REPORT ON ECONOMIC CONDITIONS IN THE UNITED STATES OF AMERICA.

Report by The Commercial Coucillor and the Commercial Secretary, His Majesty's Embassy, Washington, D.C. Pp. 112. H.M. Stationery Office. 1931. Price 3s. 2d.

In presenting their survey of Economic Conditions prevailing in the United States, the authors of this report have concentrated on the presentation of an apreciation of the board developments which have taken place in industrial and marketing methods. They have also covered the questions of credit facilities, capital investment, and general prestige and propaganda in the light of their repercussions on American trade. Basic Industries have also received individual attention, while considerable space has been allotted to a survey of the Labour Situation. The whole thus forms a composite survey of the strength of the United States industrial position. Developments in import trade are not overlooked, and a general indication is given of the scope of the Trade in which the United Kingdom may expect to participate.

Discussing the general trade conditions in the United States the authors state that the decline in general business activity in that country, which began to be felt in the middle of the year 1929 and was hastened by the effects of the collapse of the security markets in the autumn of that year, continued with unimportant interruptions throughout the whole of the calendar year 1930, and was accompanied by a general decrease in the earnings of industrial corporations, a notable reduction in the employment and earnings of industrial workers and a rather severe shrinkage in the income of the farming community. Practically every branch of both industry and business was affected, more particularly those groups of industries upon which the general prosperity of the country most largely depended and which include, besides agriculture, the building trades, automobile manufacturing, iron and steel production and the transportation industries. Their slackness produced its inevitable repercussions in every subsidiary line of industrial activity and by the end of 1930, according to the reports of the Federal Reserve Board, the output of the factories and mines of the country had dropped to the lowest levels touched for a period of eight years, and was only about two-thirds as large as in the midsummer of 1929, which the high points of the boom had been reached.

It is further stated in the Report that it is now fairly generally perceived that the year 1929, until the sudden deflation in security prices occurred, was one of too feverish prosperity supported by conditions that were abnormal and by security values that had been forced by superabundance of credit to unreasonable heights. A mental readjustment is taking place. It is being discovered that the records of 1930 do not measure too unfavourably with those of 1928 and earlier years of more moderate returns, and there is a tendency to look for the bright spots on a clouded horizon. Whatever the moral lessons of a time of

stagnation may be, the gains on the material side seem likely to prove substantial in the end; for the depression has provided an occasion for economists and producers alike to take stock of the position, and to address themselves to ways and means of checking the tendency to over-development.

Moreover, some improvement in general conditions observable since the beginning of 1931 is serving at the present moment to restore a spirit of confidence in the public mind. There has been no tangible evidence as yet that a general forward movement in business is in progress and no sudden upturn is expected in any quarter, but a more hopeful feeling is evident regarding the outlook for the current year and the rising tendency from week to week has lasted long enough to be fairly significant.

In addition to dealing with credit expansion, foreign financing and other monetary conditions, another feature referred to in the general survey on economic conditions is the instalment buying system which has been regarded by some of its apologists as the greatest prop of American prosperity in recent years and by its critics as a dangerous device likely to complicate a bad situation in hard times.

The second chapter of the report is headed "Special aspects of America's external trade." It is in this chapter that the main theme of the Report is developed. Special attention is given to America's industrial expansion and rationalisation in production and marketing, leading up to her resulting strength as a competitor in the world's markets. There are also valuable contributions respecting the position of British imports and marketing problems; in this connection the Report asserts that most things to wear in the United States are bought for appearance rather than durability. A combination of quality and style would prove an irresistible sales attraction, and in that direction lies very considerable scope for increased British trade.

Chapter III is devoted to a review of basic industries and covers the ground as comprehensively as is possible in a general report comprising the main features of economic activity. The succeeding chapters deal with the condition of agriculture, transport and communications and labour respectively.

The report is completed by eleven appendices, seven of which relate to statistics on trade and industry and may be studied in conjunction with chapters II and III.

Forthcoming Events.

FRIDAY, MAY 29.

ROYAL INSTITUTION, 21, Albemarle Street, W.1., at 9 p.m. "The Future of the Human Race," by Very Rev. W. R. Inge, K.C.V.O., D.D., LL.D.

THURSDAY, JUNE 4.

CHEMICAL SOCIETY, Burlington House, Piccadilly, W., at 8 p.m. Ordinary Scientific Meeting.

CANADIAN GAS ASSOCIATION. Annual Meeting, Windsor Hotel, Montreal.

ROYAL SOCIETY OF ARTS, John Street, Adelphi, W.C.2., at 6 p.m. "A New Form of Prime Mover and Its Uses for Locomotives, Marine, and other Engines," by J. F. J. Malone.

FRIDAY, JUNE 5.

ROYAL SOCIETY OF ARTS, John Street, Adelphi, W.C.2., at 4.30 p.m. "The Indian Paradise Garden," by Mrs. Patrick Villiers-Stuart.

PHYSICAL SOCIETY, Imperial College of Science, South Kensington, S.W.7., at 5 p.m.

ROYAL INSTITUTION, 21, Albemarle Street, W.1., at 9 p.m. "Habit—the Driving Force in Evolution," by E. W. MacBride, M.A., D.Sc., LL.D., F.R.S.

WEDNESDAY, JUNE 10.

FARADAY SOCIETY. Annual General Meeting. Burlington House, Piccadilly, W., at 8 p.m. "Laboratory Study of the Atmospheric Corrosion of Metals. Part I. The Corrosion of Copper in Certain Synthetic Atmospheres, with particular Reference to the Influence of Sulphur Dioxide in Air of Various Relative Humidities," by Dr. W. H. J. Vernon. "An Air Thermostat for Quantitative Laboratory Work," by Dr. W. H. J. Vernon. "Quantitative Humidification of Air in Laboratory Experiments," by Dr. W. H. J. Vernon and L. Whitby.

THURSDAY, JUNE 11.

OPTICAL SOCIETY. Ordinary Meeting. Imperial College of Science, S.W.7., at 7.30 p.m.

WEDNESDAY, JUNE 17.

FARADAY SOCIETY. Royal Institution, Albemarle Street, W.1. Spiers' Memorial Lecture. "Michael Faraday," by Dr. R. L. Mond.

SOCIETY OF GLASS TECHNOLOGY. Sheffield at 2 p.m.

FRIDAY, JUNE 19.

PHYSICAL SOCIETY, Imperial College of Science, South Kensington, S.W.7., at 5 p.m.

New Patents

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

13,263.—I. G. Farbenindustrie Akt.-Ges. Manufacture of hydroxycarboxylic acids of amino naphthols. May 5.

13,378.—I. G. Farbenindustrie Akt.-Ges. —Manuafcture of urethane derivatives. May 6.

Specifications Published.

347,613.—Loveluck, R. J., Thomas, J., Beckett, E. G., and Scottish Dyes, Ltd.—Production of benzoyl benzoic acid derivatives and anthroquinone derivatives therefrom.

347,695.—Holzverkohlungs-Industrie Akt.-Ges.—Production of acetone from acetylene.

337,681.—Society of Chemical Industry in Basle.—Manufacture of vat-dye-stuff.

347,601. Tyrer, D., and Imperial Chemical Industries, Ltd.—Cooling of coke and obtaining a nitrogen hydrogen mixture.

Abstract Published.

343,397.—Salts of benzylmorphine. Chemische Fabrik, Vorm Sandoz, Basle, Switzerland.

Salts of benzylmorphine with alkyl sulphonic acids of low molecular weight, which are readily soluble in water, are prepared by interaction of the free base with the free acid or by double decomposition of their salts. Examples are given of the preparation of the methane and ethane sulphonic acid salts of benzylmorphine.

The Specification as open to inspection under Section 91 (3) (*a*) describes also the use of alkyl sulphonic acids containing not more than five carbon atoms and specifically mentions propane and isopropane sulphonic acids. This subject-matter does not appear in the Specification as accepted.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

511,909.—A label device illustrating a country scene illustrating a mole hill and mole and the word MOLRAT. Chemical Substances used for agricultural, horticultural, veterinary and sanitary purposes.—Thomas Wynne Thomas, trading as The Molrat Company, and also as Hugh Davies and Company, Dover Pharmacy, 14a, Sea View Terrace, Aberdovey, Merionethshire; and 6, Pentrehendyn Street, Machynlleth, Montgomeryshire. May 13. (By Consent.)

CONFESSIONS OF GREAT SOULS.

By the REV. J. E. ROSCOE, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

The work is handsomely bound, and has a copious index for easy reference, and the work, containing as it does, the gems of thought on some of the world's greatest thinkers, will form an acquisition to any library.

By post, 5/- net.

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THE PRONUNCIATION OF CHEMICAL TERMS.

By Dr. Julius Grant, M.Sc.

The pronunciation of his own "language" is not one of the most pressing problems which confront the busy chemist, but it certainly is one to which considerably more attention might be given. The responsibility rests most heavily on the teachers, particularly these in the universities, for it is from their mouths that the chemist of tomorrow will first hear the terms which will figure largely in his everyday speech, and he will at first instinctly adopt their pronunciations.

It is a commonplace that no two chemists pronounce all their words alike, even if they have been educated and have worked subsequently under the same influences. The factors of personal choice and convenience play an important part in leading us to adopt new forms of pronunciation for the first time, and the habit grows. Unfortunately such a choice is seldom made as a result of serious thought, and hence we have a state of chaos, with only one pronunciation for three or even four syllables differing in spelling and in significance, whilst on the other hand a single word or syllable may be given several different sounds.

Now, as far as ordinary language is concerned it is well-known that the inhabitants of every class of the community, and of every district have their own ideas as to what is "correct" in the matter of pronunciation, and that these opinions are jealously defended. It has been asserted by local enthusiasts that on the one hand the London cockneys, and on the other, the inhabitants of a certain obscure village in the north are the only true exponents of the king's English! Such extreme variations tend to converge asymptotically towards an ideal among the educated classes. This asymptote representing correct pronunciation corresponds, so to speak, with a narrow band of variations rather than with a straight line. In the writer's opinion it has more in common with the pronunciations favoured in London, or at any rate, S.E. England, though this will no doubt be strenuously opposed in the North.

Fortunately, among chemists the differences are restricted to those of locality, and are therefore less marked. Nevertheless the problem of deciding which is correct is

no less difficult, and whether we consider chemical or ordinary English one definite conclusion emerges, namely, that we have no right to assume that there is one and only one correct rendering of every word.

A great responsibility therefore rests on teachers and editors and authors of publications such as Jacobson's "Pronouncing Chemical Formula Speller," and Hackh's "Chemical Dictionary" (which gives pronunciations as well as definitions). Both, incidentally, originate in America where such matters are given (and probably require) greater attention than in this country, though the latter has been adapted to British usage, and gives British and American alternatives where these exist. Even if we assume that it is possible to arrive theoretically with the aid of an expert philologist, at a pronunciation based on æsthetic considerations, we should find in many cases, that it bears no resemblance to the renderings commonly employed. It seems therefore that the responsibility of the lexicographer who wishes to produce an authoritative volume rests on his decision as to which of the traditional renderings may be considered most typical of the whole. The pedagogue may demand strict rules, but these will satisfy neither the theorists of yesterday and tomorrow, nor the average chemist of to-day whose education in chemical pronunciation is now complete for better or worse.

These anomalies have arisen from the fact that sound and sight are fundamentally different, and that there is consequently a difficulty in adapting spelling so as to convey an accurate rendering of a particular sound. In some languages, such as Chinese, the difficulty is overcome by making no attempt to represent sounds by written syllables, but by using instead a separate sign for each word. This of course means the creation of thousands of such signs, and it is fortuuate that Chinese is not one of the current languages of chemistry.

In English the number of sounds we use is about 30 and therefore exceed the number of letters available to represent them. The same letter, or combination of letters, has to play several parts, as for example the "f" sound which represented by *ph* in "phenol" and *gh* in "trough." These relations between sound and letters are purely conventional, but the conventions do not receive the same interpretation by everybody with the result that the word "amyl" may be pronounced as any combination of two syllables represented by the sounds *am-* or *aim-* and *-ill*, *-ile*, or *eel*, respectively.

Our ordinary spelling therefore, represents language as it was at the time when the printed word first became popular, *i.e.*, in about the 16th century, and the discrepancy which in the meantime has grown between the written and spoken word has never been bridged. Moreover to bridge the gap now would involve an obviously undesirable alteration of the whole system of reading and writing.

Although chemical language is saddled to a certain extent with this same anomaly, it is little more than a generation old and it is still possible by creating and observing conventions among the relatively small chemical community to avoid further confusion. Since chemistry is a synthetic language and is largely built up from prefixes and suffixes which in themselves convey definite meanings, consistency might be attained by inverting the original significance of spelling, *i.e.*, the words might with advantage be pronounced as they are spelt, and not spelt as they are pronounced. This would be doubly advantageous if it is borne in mind that, except in the case of the student, chemical knowledge is distributed mainly by the written word.

The British Broadcasting Company, in its pamphlet "Broadcast English," indicates the difficulty in deciding what form of pronunciation its announcers shall adopt. At the same time one would question the desirability of giving only one pronunciation in each case. If we select the word "patent" as an example, we may ask if northern and southern chemists would approve of the rendering *paytent*, *pattent*, being reserved only for "Letters Patent" and "Patent Office."

In Germany and France attempts to standardise pronunciation have also been made, but they are confined mainly to the stage, in which case it is obvious that, unless the play requires otherwise, two actors in the same cast should use the same pronunciations.

In America the first definite steps towards the standardisation of chemical pronunciation have recently been taken. The Committee of the American Chemical Society responsible for Nomenclature, Spelling and Prouunciation has issued an interesting questionnaire and list of words which have been sent to a selected group

of chemists which, if one may judge from the fact that some have been received in this country, is fully representative. The ultimate object is to formulate "some authoritative standards based primarily on predominant usage by chemists."

The problem is doubly difficult in America where the influence of many foreign languages on everyday speech is more pronounced than here. Thus, a group of students under a teacher of non-American origin may acquire and spread altogether strange renderings of certain words and so add to the confusion. It is even probable that a student listening to a conversation between two chemists whose pronunciations of the same words differ may not even feel sure that they are discussing the same subject.

The questionnaire appears to cater for all idiosyncrasies of pronunciation that may arise, such as the influence of residence abroad, association with foreigners and teachers, place of birth and residence and individual characteristics. Opinions are also required whether the decisions of the Committee should take into account foreign language—influence, general good usage in English, or both. Few in England would agree that foreign language influence should play any part in deciding the correct rendering of the English tongue, and one would imagine that even in America to allow it to do so would be to introduce an unnecessary and confusing factor.

This brings us naturally to the question of foreign words. Should they be pronounced in an anglicised form (the traditional method surviving from the days when few people could read any language but their own), or should they be given their native rendering? As far as proper nouns are concerned there can be little doubt that the second alternative is usually preferable, though in ordinary language such a course might at times be considered pedantic. For example who would care to tell a friend that he had arrived from "Paree"? The chemist however, so far as chemical language is concerned, may justifiably set himself a higher standard. Then perhaps we might be spared the highly individualistic renderings of words such as "Wijs" which vary from *widges* to *vice*. "Glaisen" also, takes the forms *klizen*, *klausen*, *klauzen*, and "Joule," Grignard," "Kieldahl" and many others are also offenders. The adoption of native renderings of foreign names seems an easy and desirable step towards standardisation. Even so it is not without difficulties. Thus, the German -*ch* represents a sound which does not come easily to the Englishman and is usually replaced by -*k*, and the stress in "aragonite" is another pretty problem. Also are we to have separate renderings of (say) "Paris green" for conversations in the works and in the laboratory?

The completion of the word-list provided by the American Committee demands the type of mental exercise usually associated with word puzzles. Possible alternative pronunciations of each of about 400 words are given (usually) in three columns, with a fourth column for further suggestions. The pronunciation used has to be marked and distinguished from those in current use by colleagues, and those which the writer feels are preferable to his own. A number of representative lists should therefore contain much valuable information.

The conscientious completion of one of these lists would reveal some puzzling inconsistencies among the most careful speakers. The present writer has always realised that absolute uniformity of pronunciation among chemists is impossible at present, but has aimed at system which is at any rate fairly consistent within itself, and at the same time would be considered foreign to London usage. Thus for example, suffixes which are spelt in the same way, should have the same pronunciation, and this pronunciation should differ from that of other suffixes which are spelt differently. Thus -ine is pronounced as in *pin*, -ide *tied*, -ene *been*, -en *pen*, -yl *pile*, -yll *ill*, etc. In this way primary amines have suffixes with the same sound, and may be distinguished from hydrocarbons. This of course makes no separate provision for -in, but this in inevitable unless all -ine endings are sounded as in *pine*, and -in as in *pin*—an impossibly heterodox rule. Similarly -yl is not distinguished from -ile, or -il from -yll; these similarities however are not likely to lead to confusion.

It is not easy to preserve consistency with a series of words such as "amide," "amido," "amine," "ammine," "ammino" and "amyl," for here the question of stress also enters. The writer suggests *ay'mide*, *aymi'do*, *ay'mihn*, *aymi'no*, *am'ihn*, *am'ihno* and *ay'mile*, respectively (*ay* as in "pay" and *ihn* as in "pin"). In this way we may also distinguish "benzene" from "benzine." Analogously, we

may say ihm'ide (imide), ihmi'do (imido), ihm'in (imine), and ihmi'no (imino). Some distinction should also be made between the ending -ole (pronounced as in "cold"), and -ol (pronounced as in " doll ") representing a phenol, and " enol " (ee'nol) should certainly rhyme with phenol. Words of chemical interest to which the recommendations of the B.B.C. apply are *asee'tik, ay'erated, al'abaster, cow'chook* (for "caoutchouc "), *seray'mik* (" ceramic "), *i'odyne* (!), and *labor'atory*.

At times it is desirable to adjust the stress to a particular syllable in order to emphasise a distinction from a similarly -sounding word. Hence di'chromate, mono'-, di'-, tri' and met'a-phosphates, ferri- as distinct from ferro'cyanide, and carbam'ate from car'bonate. " Laboratory " should obviously be stressed after -bor-, and not after lab-. The first syllable of " guaiacol " is sometimes pronounced gwa- and sometimes gwi- or gwee-. "Guanidine " therefore, should correspond and be pronounced gwa- and not goo-an-, or gu-an-, even though this involves a rather hurried syllable when extended to " guanine." This brings us to the troublesome " u " sound which unless it occurs as an initial or final vowel (*e.g.*, " urea " and "tolu ") should be pronounced -oo- (*e.g.*, " pyruvic "), the true -u being reserved for -eu (as in " leucite " and " heulandite").

Unexpected similarities between words far apart in meaning may surprise the speaker when by coincidence they are brought into the same sentence. "Steric" and " stearic " are examples, and the difficulty is at once removed if we say *ste'rik* (as in " stair ") and *stee'rik*, respectively, and in consequence, *stee'rol* and *steer'in*. The reader may exercise his own imagination in deciding between antimon'ic, antimoh'nic, an'timonic, an'timonii, *antimoh'*-nyl, etc., and in choosing between bo'zite, *bouks'ite, boks'ite* and *borks'ite* for "bauxite." Why, we may finally ask is the -sh sound usually given to " strontium " and " strontia " and why does the stress in " sulphur," " sulphonal," " sulphuryl," etc., occur after the first syllable, but in " sulphuric " after the second?

These examples may serve to indicate a few of the anomalies in chemical pronunciation, and some methods of overcoming them. All chemists may not agree with some of the renderings suggested, but few will dispute the desirability of consistency. The spoken word is at least as important as the written word, and it will be something accomplished to have stimulated interest in the elevation of correct speech to the status of correct spelling. Co-operation without American colleagues in the matter of spelling has already been suggested, and perhaps it is not too much to hope that co-operation in pronunciation will follow. This is desirable for many reasons, but for the meantime it seems that a little self-discipline in speech by each individual will effect something towards a more scientific system of pronunciation.

NICKEL-BARIUM ALLOY SPARKING ELECTRODES.

A study of irregularities in the sparking voltage of spark gaps has revealed the fact that small inclusions of magnesium in the nickel alloy generally employed for spark plug electrodes, distributed at random through the wire, vitally affect the sparking voltages.

The marked reduction in sparking voltage effected by magnesium shows clearly the beneficial influence of its presence, but its application is severely restricted by the fact that it does not distribute itself uniformly through the wire; it also proves impossible to incorporate in the alloy as large a proportion of magnesium as would be desirable from the point of view of the physical properties required.

Experiments on other metals as substitutes for magnesium have indicated the marked suitability of barium, and practical service tests of nickel-barium alloy for spark plug electrodes in automobile engines, for upwards of two years, have proved its ability to maintain a constant sparking voltage in long continued use. A study of electron-emission and of the structure of the material shows that the barium forms a true alloy with the nickel. While 0.05 per cent. of barium has been found adequate for use in spark plug electrodes, alloys containing higher percentages of barium are proving advantageous for use as a basis metal for oxide-coated cathodes in radio tubes, and for other uses. Tests now in progress on the nickel-barium alloys indicate promising possibilities for their use in electron devices of various kinds.

REVIEWS OF MODERN PHYSICS.

In the journal of the above title for April, 1931, vol. 3, Irving Langmuir and Karl T. Compton contribute a long report on Electrical Discharges in Gases, being Part II. The scope of this work can be judged by the following taken from the table of contents :— Electrostatic fields due to electrodes and to uniform space charges in which are treated : Forms of Poisson's equation; methods of calculating fields; capacitance; mechanical force; fields between planes, cylinders or spheres; relation of diffusion and heat conduction to potential distribution; two-dimensional cases, wires, grids and slats; electrode at one end of long tube; effect of uniform space charge on potential distribution. Flow of current in high vacuum when space charge is negligible : Electron swarms as ideal gas; single encounters; multiple small deflections; limitation of current by orbital motions of electrons; reciprocal relations between emitter and collector; saturation currents in accelerating fields; Boltzman's relation for currents in retarding fields; coaxial cylinders and concentric spheres; electrons accelerated inwards from an external emitter; electrons flowing from an internal emitter to an external collector against a retarding field; effect of electron reflection at the electrodes; effect of magnetic fields on the flow of electron currents. Effect of space charge on the flow of current in a high vacuum : Space charge equation for parallel planes; space charge equations for cylinders and spheres; space charge currents between equidistant curved surfaces; the 3/2-power law for electrodes of any shape; effects of initial velocities on space charge currents between cylinders; space charge limitation of bipolar currents.

In the same journal then follows a long article (22 pages) entitled : Some physical characteristics of speech and music, by Harvey Fletcher of the Bell Telephone Laboratories. This treatment is well illustrated by figures and there is practically no mathematics.

And finally, David M. Dennison of the University of Michigan reports at length, 66 pp., on the infra-red spectra of poly-atomic molecules, this being Part I. The introduction is instructive, apart from the main treatment, and the following is taken from the original with a few trifling condensations :— When atoms combine there are many questions to be answered. Perhaps the most important is whether a given set of atoms can combine or not to form a molecule. Chemists relied upon valence here, and while this was satisfactory in justifying the structure or composition of compounds and in predicting new compounds, it has not been possible until recently for the physicist to interpret valence rules in the light of quantum mechanics. The work of Heitler and London (*Zeit. für Physik*, 1927, *44*, 455) on the formation of homopolar diatomic molecules has shown that valence is to be connected with the symmetry character of the wave functions of the outer electrons in each atom. These ideas have not yet been applied in detail to molecules with more than two atoms, but there is little doubt that they can be so extended. Whether a set of atoms may form a stable molecule depends upon the electronic states of the individual atoms. In the present article the electronic state of the molecule will not be considered nor the spectral bands involving *changes in electronic energy*. Rather it will be assumed that a stable configuration of the atomic nuclei does exist, and the problem treated is that of the space configuration of the nuclei and the force functions acting upon the nuclei in the neighbourhood of their equilibrium position. Although this neglect of spectra involving a change in the electronic state is a great limitation of the general problem of molecular structure it is partly justified by the fact that so little is known experimentally about such spectra, whereas there exists a great body of data on the infra-red bands. Undoubtedly more experimental information can be obtained relating to the visible and ultra-violet bands of polyatomic molecules, and this may present one of the most interesting problems to be attacked in the near future. Recent books are referred to here, which are of great value, these being on infra-red spectra. In this article Part I comprises an exposition of the methods for studying the infra-red spectra of polyatomic molecules. The order of the sections, the *vibrational*, the *rotational*, and the *symmetry properties* of molecules, is based upon the appearance of a spectrum as viewed with spectroscopes of progressively higher resolving powers. The gross features of a spectrum are the positions and intensities of the bands and these depend wholly upon the vibrational properties of the molecules. Greater resolution reveals the existence of fine structure in the bands which is to be associated with

the rotation of the system and eventually may show certain intensity ratios among these lines which can only be explained when the symmetry character of the wave functions are taken into account. Part II, to follow in a forthcoming issue, will contain a detailed application of these methods to the interpretation of the infra-red spectra of a number of the more important polyatomic molecules.

F. H. L.

THE WILBERFORCE RADIUM OCCURRENCE.

By Hugh S. Spence and R. K. Carnochan.

(*Mines Branch of Canadian Mineral Resources and the Mining Industry.*)

This report deals with an occurenee of radium ore near Wilberforce, Haliburton county, Ontario, upon which development work has recently been undertaken and which seems more likey to prove of commercial grade than any other deposit of radioactive minerals hitherto found in Canada. This occurrence is sometimes called the Richardson property, after Mr. W. M. Richardson, the discoverer.

Occurrences of radioactive minerals are not uncommon in eastern Canada, and a number are recorded in the literature. The earliest of such references is probably that in Geology of Canada, 1863, where is mentioned an occurrence of uranite at Mamains, on the east shore of lake Superior. The mineral was first described by J. L. LeConte. in 1847, under the name of coracite, and was said to occur in a two-inch vein at the contact of a trap and syenite. Search for this locality in recent years has proved unsuccessful.

Obalski, in 1894, mentions the occurrence of uranite at a mica mine near Murray Bay, Quebec. In 1903, Obalski records tests made on this uraninite by Rutherford and the Curies, and the determination in it of the then newly-discovered element radium. In 1901, he mentions the occurrence of uraninite at the Villeneuve mica mine, on the Lièvre river; and of samarskite at the Maisonneuve mica mine, in Berthier county.

Most of the earlier discoveries of radioactive and rare earth minerals in Canada were thus made in pegmatite dykes in Quebec province, where they were found during mica mining operations.

Later, other discoveries of these minerals were made in similar association in pegmatites worked for either mica or feldspar, both in Quebec and Ontario, and now the list of localities where radioactive minerals are known is a fairly large one. All of such occurrences, however, are in normal granite pegmatites, the minerals being found usually disseminated irregularly and, in small amount through the dyke mass or in small pockety zones in the dykes.

Up to the present, the only occurrence of a radioactive mineral that it seemed possible might have commercial possibilities has been that of euxenite, which was found in some quantity in a feldspar quarry in South Sherbrooke township, Lanark county, Ontario, in 1917. A small shipment of ore from this deposit was sent to the Mines Branch in 1919 for concentration tests and from it a few hundred pounds of concentrates were made; however, no attempt at commercial production was made by the owners. Euxenite is not particularly rich in uranium (7 to 9 per cent. U_3O_8) and accordingly there is comparatively little market interest in it as a source of radium.

It should be noted that radioactive and rare earth minerals are not by any means peculiar to Canadian pegmatites. It is with this type of rock that such minerals are usually found associated the world over, and in some countries, notably in Norway and Sweden ,as well as in India, Madagascar, and Tanganyika, pegmatites occur that are probably far richer in radioactive minerals than any found in this country prior to the Wilberforce discovery. However, except in Madagascar, no serions attempt at mining such pegmatites for their radium-bearing minerals has ever been made, though small amounts have been recovered during mica and feldspar mining operations. It is believed, however, that most of such material has found its way as specimens into mineralogical collections and not to have been used as a commercial source of radium. It does not appear likely, basing the belief on what appears to be the general world occurrence of pegmatitic radioactive minerals, that the ordinary run of pegmatites in Canada can be seriously regarded as a potential, commercial source of radium ore.

The Richardson deposit, while associated with pegmatite, differs in several important respects from other recorded occurrences of such minerals, either in Canada or (as far as the writer is aware) in other countries,

and the amount of uraninite thus far obtained from small surface workings greatly exceeds that yielded by all Canadian mica and feldspar mines. The total quantity of uraninite, amounting to several hundred pounds, thus far taken from the property, and all obtained practically from the surface, may be regarded as a promising indication that the occurrence will prove to describe the main features of the deposit and the results of development to date.

History.

The first discovery of radium ore in the Wilberforce district was made in 1922 by Mr. W. M. Richardson, a prospector and miner with Alaska and Yukon experience, who had come to Wilberforce in connexion with the finds of molybdenite that had been made near that place and had taken up residence about one-half mile northwest of the site of the present operations. In the course of prospecting the district, Mr. Richardson found a heavy, black mineral in surface outcrops of pegmatite at different points on the property, and having obtained a sample of Joachimstal pitchblende, identified this mineral as uraninite. He, therefore took up the mining rights of lots 4 and 5 in concession XXI, and on lot 4 in concession XXII, and proceeded to open up a number of small prospect pits and trenches.

A sample of the uraninite sent by Mr. Richardson to Ledoux and Company, of New York, for assay was reported by them to contain 58,35 per cent. of uranium oxide (U_3O_8), equivalent to a radium content of 147 milligrams of radium per ton.

From a search of the literature, the only recorded occurrence that in any way resembles geologically and mineralogically the Richardson orebody appears to be a deposit at Wölsendorf, in Bavaria. At the latter locality, dark purple, fetid fluorite is found in a lead with autunite, torbernite, and uranophane, all alteration products of pitchblende, traces of which also occur.

Minerals of the Deposit.

Apatite. Apatite occurs in considerable amounts as free crystals in the calcite-fluorite matrix. The crystals are sometimes of considerable size, ranging up to 30 pounds in weight. Several dozen loose individuals were taken by the writer from a small pocket, the calcite of which had been leached out by surface waters. The prism faces are well developed, but good terminations and being pitted and rounded. There is apparently no development of compact, massive anatite.

The colour is usually brownish green to brown or yellow. Like the apatite of other smaller deposits in the district, and in contrast to that of most pyroxenite deposits, the mineral is clear and glassy and exceedingly brittle. Clear fragments of considerable size and without visible flaws can often be picked from broken crystals.

An interesting feature of the apatite of the Wilberforce district is that where crystals exhibit terminal faces there is always a conspicuous development of the basal plane. This is sometimes so pronounced that the crystals appear to have almost square ends. The basal plane is seldom, if ever, found on the pyroxenitic apatite of the Ottawa region.

Biotite. Biotite mica is stated to occur sometimes in large plates, in the massive pegmatite of the west pit. It was not observed in noteworthy amount in the main, or middle pit.

Calcite. Calcite is one of the principal constituents of the lead. It is mostly rather fine-grained and has a faint pinkish colour. As in the pitchblende veins of Czechoslovakia, the colour deepens to a brownish red in close proximity to uraninite nodules or crystals, and thus dark-coloured calcite serves as an indicator for uraninite.

Feldspar. Feldspar, of a buff to reddish cast, is the principal constituent of the pegmatite with which the uraninite is associated. It is medium- to coarse-grained and probably is predominantly orthoclase (potash feldspar). There is possibly a certain amount of soda or lime-soda feldspar also present, but no information on this point, based on analyses or microscopic examination, is available.

The walls of the miarolitic cavities in the pegmatite are lined with wel-formed feldspar crystals which often attain a length of several inches. This mineral always forms part of the pegmatite proper and it is not found as free crystals in the calcite-fluorite filling of cavities, as are the apatite, hornblende, magnetite, etc .

Fluorite. As one of the principal constituents of the filling of cavities in the pegmatite, fluorite is possibly the most interesting gangue mineral present.

When fresh, its colour is always of a dark reddish purple to violet shade, deepening in close proximity to uraninite to almost black. In this respect, it resembles the fluorite of other deposits of radioactive minerals throughout the world, and it may be taken as established that the dark colour

is due to radioactive emanations. The colour of all such fluorites fades on exposure to light and the mineral eventually becomes colourless.

When disseminated through calcite, the fluorite is in the form of small shapeless grains. It also forms bands or stringers and is then usually fine-textured to dense and compact. The last type is always found in close assication with uraninite, and thus serves as an indicator for that mineral.

A pecularity of such compact fluorite is that it gives off a strong odour when crushed or freshly-broken. This odour is of practical service to the workmen as an additional indiction that they are breaking into a pocket of uraninite. The smell resembles that of ozone and is believed to be due to free fluorine.

The conspicuously dense texture and almost black colour of the fluorite accompanying the uraninite, and the reddish brown colour assumed by the calcite in similar association, would prove a useful aid in preliminary rough-sorting of the ore enabling the rich material to be readily separated in the pit from the lower-grade or barren gangue.

Hornblende. Large, free crystals of hornblende, sometimes over 12 inches across, frequently occur in the calcite-fluorite filling of the main or middle lead.

Magnetite. Magnetite is fairly abundant, occurring as large crystals or irregular masses in miarolitic calcite-fluorite. It was observed in greatest amount in the west and middle pits.

It is frequently intergrown with uraninite, and sometimes also with apatite aud hornblende.

Molybdenite. Small traces of molybdenite are stated to have been found in the massive pegmatite of the west pit.

Uraninite. This, as far as known, is the only radioactive mineral occurring in any important amount on the property. Small amounts of its alteration products, in the form of orange and yellow incrustations of uranium salts, as well as traces of torbernite,, the copper uranium phosphate, are found in association witb it, but these are hardly of commercial significance. Up to the present, none of the radioactive, rare earth minerals ,not infrequently found in the ordinary granite pegmatites of eastern Canada, have been reported here.

The uraninite occurs as well-formed crystals and as nodular lumps. The crystals are often of unusual size, frequently measuring one inch or more across. They are of cubic habit, usually more or less modified by the octahedron. The lumps range from small individuals the size of a pea to masses weighing several pounds.

In the massive pegmatite of the west pit, the uraninite is stated to have been found chiefly associated with black mica and often enclosed in mica " books." Unlike its occurrence in the middle pit, it does not seem to occur here in miarolitic cavities.

In the lead of the middle pit, the uraninite crystals and masses occur scattered through the calcite-fluorite filling, apparently without any regular system, but, as noted above, always in close association with dark purple fluorite. The same distribution holds at the outcrop 300 feet east of the middle pit.

As regards the relative abundance of uraninite in the deposit, Mr. Baycroft's report states that a sample taken across 30 feet of pegmatite at the west pit yielded a little over one per cent. U_3O_8, equivalent to 28.56 pounds of uraninite per ton. The carload shipment sent to the Mines Branch, and representative of the ore of the middle lead, showed a recoverable uraninite content of 4.56 pounds per ton.

Two complete analyses of the uraninite have been made and are given below. The first is by E. W. Todd and the second by H. V. Ellsworth. Both analyses were made on selected, clean mineral, and it is interesting to note that they differ considerably in uranium content. The sample analysed by Ellsworth is noted by him to have consisted of severely altered material, to which fact it attributed the low UO_2 content as compared with that of the sample analysed by Todd. Much of the uraninite mined during 1929, and examined by the writer, was observed to be similarly altered, the outer portions both of crystals and lumps consisting of a blackish green earthly material soft enough to be readily rubed off by the fingers. The alteration is especially pronounced in the uraninite taken from leached cavities in the lead and would seem to have been effected by surface waters. The uraninite broken out of fresh fluorite or calcite has a much fresher and more lustrous appearance and probably more nearly approaches in composition that analysed by Todd, which came from the massive pegmatite in the west pit. The specific gravity of the latter is given as 9.082. No figure is given by Ellsworth for the sample analysed by him, but determinations on two specimens—one a crystal and

the other a massive lump—from the shipment sent to the Mines Branch in 1929 showed a mean of 8.83.

Analyses.

I.

UO_2	45.18
UO_3	24.90
ThO_2	11.40
Ce_2O_3, etc.	1.82
Y_2O_3, etc.	2.74
MgO	0.19
CaO	0.28
MnO	0.04
PbO	10.40
Fe_2O_3	0.58
H_2O	0.61
SiO_2	0.43
He	0.35
Total	98.92
Equivalent to U_3O_8	69.71

Specific gravity = 9.082

H_2O at 100° C	1.49
H_2O above 100° C	0.11
Insoluble	0.67
SiO_2	0.58
PbO	11.05
ThO_2	13.56
UO_2	13.55
UO_3	52.04
Ce group oxides	1.85
Yt group oxides	1.24
Fe_2O_3	0.47
Al_2O_3	0.11
MnO	0.003
TiO_2	0.001
CaO	0.25
MgO	0.07
CO_2	0.67
SO_4	0.58
P_2O_5	0.04
F, alkalis	Present
Loss on ignition	4.42
Total	98.33
Equivalent to U_3O_8	61.64

Specific gravity not stated.

It may be noted, in passing, that the mineral uraninite is of scientific interest as enabling the geologic age of the rocks in which it occurs to be calculated from the contained lead-uranium ratio. Such calculations based on Todd's analysis show an age for the Wilberforce pegmatite of 1,239 million years. Ellsworth's analysis indicates 1,299 million years. The difference is possibly to be accounted for by the probability that altered uraninite may yield a somewhat higher lead ratio than fresh mineral from the same occurrence.

Zircon.—Zircon is a minor rock-forming constituent of the pegmatite dyke, in which it occurs as small crystals measuring about ⅛ by ⅜ inch. It appears to have rather a zonal distribution, being quite abundant in some parts of the rock while not visibly present in others.

Conclusions.

The ore is easily concentrated and the concentrates obtained are of good grade.

The tests showed a value of $22.73 for the radium contained in the concentrates obtained from one ton of ore. Whether the ore is commercial will depend on the tonnage available; cost of mining and milling; cost of chemical treatment of the uraninite concentrates; amount of loss of uranium and radium in treatment; and the price obtainable for the refined products.

Commercial Possibilities.

The results of the work thus far conducted on the property, particularly that done during 1929, which has proved the existence of a well-defined, uraninite-bearing lead believed to be at least 500 feet long, and in places 10 to 12 feet wide, cannot but be considered as encouraging, as far as a supply of ore is concerned. While little can be said at this juncture regarding the probable downward persistence of this ore-body, the fact that it appears to represent a marginal deposit along a large pegmatite body, of which it forms an integral part and to which it is genetically related, suggests that it very possibly extends to a considerable depth. Being of miarolitic character, it bears a striking resemblance to the pyroxenitic calcite-apatite-mica bodies of the Ottawa region, some of which have been mined to depths of over 500 feet without exhaustion. Such bodies are, however, often pronounced pockety and pinch and swell very irregularly.

From the angle of development, the deposit enjoys the advantage of being situated close to rail and on a surface that could hardly be bettered for easy and cheap mining. Lying along the brow of a ridge sloping almost directly from the outcrop, it is so placed that in the even of a mill being built, ore would fall into the bins by gravity. There is a hydro-electric power site capable of producing 500 h.p. within two miles of the property.

The ore, as shown by the large-scale test made by the Mines Branch, is easily crushed and concentrated, and only limited mill equipment, consisting of crusher, rolls,

classifier and tables, is required to make a uraninite-magnetite concentrate. This can be readily treated on a magnetic separator, with the production of a uraninite tailing that, on re-tabling, yields a clean product.

In addition to the radium value, there is the value of the uranium. The value of the associated thorium is problematical, since the world's supply of this element is believed to be supplied entirely from treatment of the mineral monazite, large supplies of which are available. The value of the thorium oxide content in 1 ton of the pure uraninite, based on the current marprice of 64 cents per pound, is $160, or 36 cents per ton of ore.

Market for Radium and Uranium.

The world demand for radium for therapeutic purposes continues to be as insistent as ever and can hardly be met owing to the extraordinarily small supply and the high price demand. According to the latest volume of Mineral Industry, the price quoted in the United States during 1928 was $70,000 per gramme. The same figure appeared throughout 1929 in the market quotations of Engineering and Mining Journal.

Outside of its use in surgery and therapy, for which it is chiefly in demand, radium has also been employed to a considerable extent as an ingredient of luminious paint, used principally on the dials of instruments and watches. For this purpose it is mixed with specially prepared crystalline zinc sulphide, in the proportion of 0.1 to 0.25 milligram of radium to 1 gramme of the sulphide. Owing to the attendant danger to workpeople employed in usuing such paint which danger has recently received considerable publicity by actions for damages in the United States courts, efforts have been made to have its use prohibited by law, and it is likely that action along such lines will be taken in all countries. A satisfactory substitute for radium for the above purpose has been found in mesothorium.

While no exact figures are available, it has been recently stated that the total world supply of radium existing and available for therapeutic purposes is only 300 grammes, or a little over half a pound.

Most of the supply is now obtained from deposits in the Belgian Congo, which are operated by the Union Minière du Haut Katanga, the ore being shipped to Belgium for the extraction of the radium. In 1928 this company reported a production of 40 grammes which was double the amount produced in 1926. It is stated that the Belgian works are being enlarged to make for a further increased output, the Union having adequate supplies of ore at their mines to produce on a much larger scale. Considerable secrecy seems to have attended this company's operations, and it has incurred much criticism on the score of maintaining a radium monopoly and charging exorbitant prices, out of all proportion to the cost of production, for a substauce whose chief usefulness consists in the alleviation of human suffering. In a recent press article the Union has come out in its owu defence and has endeavoured to show that since 1923, when it came iuto active production, it has repeatedly lowered its prices, and that it is due to its entry into the field that the former high price of $120,000 per gramme, which obtained when the United States was the principal producer, has been reduced to the present level.

Prior to 1921, most of the radium production was supplied by American companies extracting the element from carnotite ore mined in Colorado and Utah; this ore was worked primarily for its vanadium content, the radium being recovered as a by-product. Owing to its low grade (about 2 to 5 per cent. U_3O_8), as compared with uraninite (60 to 90 per cent. U_3O_8), production has gradually fallen off and in 1928 no radium was isolated in the United States.

In Czechoslovakia, the present radium production is stated to be at the rate of about 3 grammes per year. It is obtained from pitchblende, the same mineral that occurs in the Belgian Congo, and of which the Wilberforce ore is a crystallized variety. It was in this ore that the element radium was first detected by the Curies, and prior to the development of carnotite mining in the United States, Czechoslovakia was the world's most important source of radium ore.

The total present annual production of radium is thus practically confined to the Belgian Congo output of 40 grammes and the 3 grammes produced by Czechoslovakia. Allowing for a further small production from unrecorded sources, it would seem that the total world production is under 50 grammes per year.

Deposits of radium-bearing minerals are known in a number of other countries, including Portugal, South Australia, Mexico, Madagascar, Transvaal, Cape Province, Russian Turkestan, England (Cornwall), etc. Development work has been con-

ducted in some cases ,but it is not known that any of the deposits have shown to be rich enough to work under existing market conditions.

It has recently been reported that investigation of pitchblende deposits in the Transvaal, north of Johannesburg, has shown the existence of ore in commercial quantities; and it has even been stated that an annual production of 25 grammes of radium may be expected from this source. The report, however, lacks official corroboration. It was also stated in 1929 that an English company had been formed to take over certain Czechoslovakian occurrences, and the Cornish and South Australian deposits. The Turkestan occurrences, which have produced small amounts of ore, are now being further investigated by the Russian Government.

The Katanga nraninite deposits in the Belgian Congo are at the present moment by far the most important occurrence of radium-bearing minerals known. They seem capable of a greatly-increased output and exercise complete control of the market. It is held, however, that every effort should be made to discover sources of radium within the Empire, and the results of the work now proceeding on the occurrence with which this paper deals will, therefore, be awaited with much interest.

STANDARDISATION IN SCHOOL LABORATORIES IN CZECHOSLOVAKIA.

A committee, appointed by the Czechoslovak Ministry of Education, has been examining the methods of equipment of technical and secondary school laboratories. On of their recommendations is that there should be more standardisation in the types of apparatus and instruments supplied to such laboratories. Complete plans for furnishing physical, chemical and biological laboratories in primary, secondary and high schools have been put forward and the committee now intend to meet the manufacturers with a view to negotiating with them on the matter of standardisation and of cost of production. One aim has been to improve the equipment in those schools which it is at present considered inadequate for modern needs in the teaching of science

OPTICAL EXPERIMENTS WITH ELECTRONS.

(Lecture delivered by PROF. G. P. THOMSON, F.R.S., before the Optical Society on May 14, 1931.)

It is now seven years since L. de Broglie brought forward the view of the duality between waves and particles which is now almost universally accepted under the name of wave mechanics, and which represents one of the greatest advances in physics of this, or any other, century. The original treatment was a development of the theory of relativity, but this side of the theory can no longer be kept in its original form. It appears, in fact, that the requirements of relativity are closely connected with the magnetic properties of the electron which gave rise on the older theory to the idea of a "spinning electron" and were not considered by de Broglie. I do not propose to deal with these to-day, and shall give the theory in the approximate form, which is sufficient to explain the experiments I have to describe.

The basis of the whole if a duality between waves and particles which is common both to matter and radiation. Maxwell made optics a branch of electricity; if de Broglie has not reversed the relation he has at least shown both as different cases of a common principle, which is more like old-fashioned optics than old-fashioned electricity. The duality takes this form; any observable event is representable as the arrival or departure of a particle at or from a small region of space, but laws which govern these events involve a quantity which is best thought of as the amplitude of a wave (possibly in multidimensional space). In the case of light this quantity is indeed the electric or magnetic vector of Maxwell wave (it is indifferent which).

In the case of electrons it is more elusive ψ which obeys also an equation of the type known to mathematicians as a wave equation. In general ψ is complex, for the equation is complex, so no direct physical meaning can be assigned to it. Its modulus $|\psi|$ is real and de Broglie gives as his "principle of intereference" the statement that the chance of the presence of an electron at a given place and time is proportional to $|\psi|^2$. The analogous statement in optics is that the chance of a quantum of light appearing at a given place and time is proportional to the square of the amplitude of the Maxwell wave.

According to de Broglie's theory the wave length associated with a free electron is λ

$= h/mv$ where h is Planck's constant and mv the mementum. He enunciates therefore a " law of spectral distribution " according to which the chance of the presence of an electron with a given momentum is proportional to the square of the modulus of the Fourier component of the wave whose λ corresponds to the given momentum. In optics, the change of the appearance of a quantum of energy W is proportional to the square of the Fourier component of the Maxwell wave of wavelength hc/W.

This simple correspondence between electron and quantum—ψ wave and Maxwell wave—in the case of the free electron, prepares us for a close experimental analogy. In fact, we can repeat many optical experiments with electrons and get strikingly similar results. The chief differences are due to the smaller wave length, which is usually less than that of X-rays, and the much smaller penetrating power. Davisson and Germer made experiments with electrons whch are the aualogy to the diffraction of X-rays by a single crystal, as in the Bragg method.

Other experiments have reproduced with cathode rays the diffraction of X-rays by a crystalline powder, and have verified de Broglie's law of wave length with considerable accuracy. Some recent work with cathode rays and single crystals of copper and silver provides the electron analogy to the optieal experiments in which two transmission diffraction gratings are superposed with their rulings inclined to each other. The etched surface of the single crystal is apparently covered with a numher of small lumps, probably the material left between etching pits. The cathode rays strike the crystal at a small glancing angle to the main surface, and pass through the lumps being diffracted by the atoms in them. If the thickness of the lump, in the direction in which rays traverse it, is less than a certain amount, which for the angles of diffraction and electronic wave lengths used is of the order 10^6, the thickness has no influence on the pattern. The diffracting system is then equivalent to an arrangement of atoms in the plane normal to the rays, and this two-dimensional array is mathematically equivalent to the crossed gratings of the optical experiment, giving rise to an array spectra which is reciprocally connected with the atomic array producing it.

The spectra, when received on a fluorescent screen, are bright enough to be shown to a small audience.

GENERAL NOTES

CANADIAN SODIUM SULPHATE PRODUCTION DURING 1930.

That the alkali lakes of the Prairie Provinces of Canada have materially added to the mineral production of the West, will be fully demonstrated when the final figures for the year 1930 are published, according to L. H. Cole of the Dominion Department of Mines, Ottawa.

The production in 1929 from these deposits totalled 5,018 tons, and a preliminary report issued by the Dominion Bureau of Statistics, Ottawa, shows the 1930 figure to be 31,571 tons, an increase of well over 500 per cent. This increase is the more gratifying in that it has taken place during a period of industrial depression.

The large increase in the output of anhydrous sodium sulphate (salt cake) from the deposits in western Canada may be attributable to two causes, shipments to the International Nickel Company at Copper Cliff, Ontario, where the material is being treated with sulphuric acid to make acid sodium sulphate (nitre cake) for use in the metallurgical process for the separation of copper and nickel, and increased consumption of the natural product by sulphate-pulp mills.

During 1929, some 80,900 tons of nitre cake were imported into Canada wholly for use in nickel refining. To prepare this amount in Canada, using the anhydrous salts of western Canada, would require an output of 45,000 tons from the deposits. Since shipments from the deposit that is supplying Copper Clig did not commence until June, 1930, the whole requirements of the refinery were not supplied last year; during 1931 a greatly increased production for this purpose may be anticipated.

According to the statistics of the Pulp and Paper industry for 1929, 44,882 tons of salt cake were consumed in Canada for the manufacture of sulphate pulp. During recent years some of this has been obtained from Canadian sources, and it is expected that during 1931 a greatly increased proportiou of the pulp mill requirement will he supplied from these sources.

It would appear, therefore, that this industry, based on the natural deposits of western Canada, in which surveys undertaken by the Department of Mines, Ottawa, have proven up more than 120,000,000 tons of hydrous salts, has at last been placed on a sound commercial basis and that as the

years go on the production will steadily increase and prove a valuable asset to the mineral industry of the country.

The Department of Mines has published a report, dealing with the sodium sulphate deposits of western Canada, copies of which may be obtained by application to the Deputy Minister.

THE CHEMICAL MARKET.

The Chemical market was quiet during April, the first half of the month being affected by the Easter holiday. In the industrial chemicals group several products have been subject to keen competition. but quoted prices have been steady on the whole. Acetone and acetic acid have been in fair demand, and there has been steady business in formaldehyde. The scarcity of Cornish arsenic continues, and supplies of this product were almost unobtainable towards the end of the month. In spite of increased activity in the markets for coal tar products, stocks are still heavy and higher quotations have not been obtained. There have been increased orders for cresylic acid both at Home and abroad, and the Home sales of creosote have been satisfactory. Refined coal tar has also been in good demand, but competition in this market is very keen.

There is nothing outstanding to report in the pharmaceutical section. Business has been steady with few price changes. Vanillin has been the brightest spot in the market, reports of brisk sales having been received throughout the month. Other products in steady demand have been aspirin, phenolphthalein and hexamine.

THE RAYON INDUSTRY.

The general improvement in demand for rayon yarns continued throughout last month, although prices have been cut. Home trade still provides the most promising market in the majority of cases. The chief demand here is for corset cloths and good rayon wraps, but the demand for furnishing materials has suffered a decrease, which is probably only seasonal or due to style changes. The result of the negotiations now being conducted in Berlin with a view to stopping the price-cutting campaign in the Central European viscose industry is being anxiously awaited by the whole rayon industry of this country.

LANCASHIRE TEXTILE MACHINERY MERGER.

Six textile machinery companies of the cotton industrial area, with a total issued capital of £7,321,160, have agreed upon amalgamation ,subject to the consent of the shareholders.

The scheme was prepared by Sir Gilbert Garnsey, of Price, Waterhouse and Company, and the companies concerned are as follows :

Asa Lees and Company, Oldham.
Brooks and Dovey (1920), Manchester.
Dobson and Barlow, Bolton.
Howard and Bullough, Accrington.
John Hetherington & Sons, Manchester, and
Platt Brothers and Co., Oldham.

Many difficulties have had to be surmounted during the preliminary negotiations, but the scheme should help the textile machinery industry by the pooling of experience, resources and research, by the elimination of wasteful competition, and by increasing efficiency in various directions.

KEY INDUSTRIES.

A representation has been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding diphenyl oxide.

Section 10 (5) of the Finance Act, 1926, is as follows :—

> " The Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act, 1921, as amended by this Act, for such period as may be specified in the order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that there is no reasonable probability that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Any communication should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, S.W.1, within one month from the date of this notice.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated to the Society :—

Sinomenine. XXIV. The Formation of 1-Thebenone from Sinomenine. By KAKUJI GOTO, HIDEO SHISHIDO and REIKICHI INABA.

Electrolytic Reactions of Leucic Acid. By YOSHITARO TAKAYAMA and HARUOMI OEDA.

The Constitution of Myricitrin. By SHIZUO HATTORI and KOZO HAYASHI.

The Relation between Boiling Point and the Position of Double Bond. By YASUJI FUJITA.

The Relation between Boiling Point and the Position of Hydroxyl Group. By YASUJI FUJITA.

The Relation between Boiling Point and Hemicyclic Double Bond. On the Existence of α-Terpinolene and β-Terpinolene. By YASUJI FUJITA.

Velocity of Reaction between Nitric Oxide and Hydrogen Sulphide. By SUSUMU KINUMAKI and HITOSHI TOMINAGA.

Volatile Constituents of the Leaf of Chamaecyparis formosensis Matsum. By KINZO KAFUKU and NOBUTOSHI ICHIKAWA.

The Determination of Bismuth. (Studies on Gravimetric Analysis by Means of Thermobalance. IX). By KOO WHA LEE.

The Determination of Palladium. (Studies on Gravimetric Analysis by Means of Thermobalance. X.) By MAKOTO TASHIRO.

March 14.

Solarisation of Fluorite and the Law of Luminoactive Transformation. By SATOYASU IIMORI and EIICHI IWASE.

Catalytic Reduction and Absorption Spectrum of Monoterpenes. By MOTOE HAGIWARA.

Stereochemical studies on the derivatives of Hydronaphthalene. III. By SAKUJIRO KIMURA.

Studies on Asphalten. By SHOZO YAMAGUCHI.

NOTICES OF BOOKS.

Spectrum Analysis in Mineralogy. By A. A. FITCH, A.R.C.S., D.I.C., Ph.D., F.G.S. Pp. 52. Adam Hilger, Ltd., 24, Rochester Place, Camden Road, London, N.W.1. Price 1s. 9d. nett. 1s. 11d. post free.

This pamphlet deals with the technique of spectrum analysis, qualitative and quantitative analysis of minerals, analysis of mineral concentrates, rocks, meteorites, natural waters, X-ray analysis of minerals, identification of minerals by absorption spectra, examples and bibliography. Some of these subjects are only referred to briefly, but there is a long list of elements as found in specified minerals with references to the work thereon. This survey is intended to show the general procedure in analytical work and much guiding information is contained between its covers.—F. H. L.

RECENT PUBLICATIONS OF MELLON INSTITUTE.

Mellon Institute of Industrial Research, Pittsburgh, Pa., has just issued the Fourth Annual Supplement to its *Bibliographic Bulletin No. 2.* This supplement lists the books, bulletins, journal contributions, and patents of the institution's members during the calendar year 1930.

The Institute has also published the *18th Annual Report* of its director, Dr. E. R. Weidlein, to the board of trustees of the institution, which describes the investigational activities throughout the fiscal year, February 28, 1930, to February 28, 1931.

Complimentary copies of these booklets will be sent to research workers, science teachers, and librarians upon request.

In the fifty-fifth Annual Report of H.M. Inspectors of Explosives (for 1930), pp. 45, published at 9d., by H.M. Stationery Office, it is pointed out that the year has been uneventful in explosives and petroleum matters but administrative work on committees and enquiries has been particularly heavy. There were no modifications of the law during 1930, only one death occurred in factory premises licensed under the Explosives Act for the manufacture of explosives. There were no deaths during 1929. The total number of visits paid was 1122 of which 211 were to factories and 450 to magazines. The total number of licensed factories is now 86.

The number of samples analysed by the Research Department at Woolwich was 352. Only 8 were reported against.

Details are given of the 14 accidents which occurred in factories engaged in the manufacture of explosives.

The *Report* also contains tables and statistics relating to the year under review.

Forthcoming Events.

TUESDAY, JUNE 9.

MINEROLOGICAL SOCIETY, at 5.30 p.m. General Meeting. "On an occurrence of Vanadiferous Node on the Coast of South Devon," by Mr. G. E. L. Carter. "Studies on Zeolites." Part II. "Thomsonite (including Faroelite) and Gonnardite," by Mr. Max H. Hey. "An Account of British Mineral Collectors and Dealers in the 17th, 18th, and 19th Centuries (continued)," by Mr. Arthur Russell "Hoba (South-West Africa), the Largest Known Meteorite," by Dr. L. J. Spencer. "Twelfth List of New Mineral Names," by Dr. L. J. Spencer. "On Different Habits of Fluorite Crystals," by Dr. J. L. E. Drugman.

WEDNESDAY, JUNE 10.

FARADAY SOCIETY. Annual General Meeting. Burlington House, Piccadilly, W., at 8 p.m. "Laboratory Study of the Atmospheric Corrosion of Metals. Part I. The Corrosion of Copper in certain Synthetic Atmospheres, with particular reference to the Influence of Sulphur Dioxide in Air of Various Relative Humidities," by Dr. W. H. J. Vernon. "An Air Thermostat for Quantitative Laboratory Work," by Dr. W. H. J. Vernon. "Quantitative Humidification of Air io Laboratory Experiments," by Dr. W. H. L. Vernon and L. Whitby.

ELECTROPLATERS AND DEPOSITORS' TECHNICAL SOCIETY. Northampton Polytechnic Institute, London, E.C.1, at 8.15 p.m. "Continental and American Practice in Nickel Deposition," by W. T. Griffiths.

INSTITUTION OF CIVIL ENGINEERS. Great George Street, S.W.1. Conversazione.

COKE OVEN MANAGERS' ASSOCIATION. Station Hotel, York, at 11.45 a.m. General Council Meeting.

THURSDAY, JUNE 11.

OPTICAL SOCIETY. Ordinary Meeting. Imperial College of Science, S.W.7, at 5 p.m.

MONDAY, JUNE 29—FRIDAY, JULY 3.

Internationl Congress of the History of Science and Technology, London.

MONDAY, JULY 13—FRIDAY, JULY, 17.

INSTITUTION OF MECHANICAL ENGINEERS. Cambridge Summer Meeting.

MONDAY, JULY 13, TO SUNDAY, JULY 19.

S.C.I. Jubilee Celebrations and Fiftieth Annual Meeting. Headquarters, Great Central Hotel, Marylebone, London, N.W.1. MONDAY, JULY 13. 11.30 a.m. Opening of Chemical Plant and Research Instruments Exhibition by the President. 1 p.m. Luncheon, Hotel Victoria, W.C.1. Tickets 6s. 6d. 3 p.m. Reception by Lord Mayor and Sheriffs at Guildhall, E.C. 8.15 p.m. Reception by the President and Lady McGowan, Great Central Hotel, N.W. 9 p.m. Musical entertainment. TUESDAY, JULY 14. 10 a.m. Council meeting. 10.30 a.m. Annual General Meeting, Royal Academy of Music, Marylebone, N.W. 12.45 p.m. Luncheon, Great Central Hotel. 2.10 p.m. Start for Garden Party, Lensbury Club, Teddington. 5.30 p.m. Reception of Original Members, Girdlers' Hall, E.C. 7 p.m. Reception and meeting by the Master of the Salters' Company, Salters' Hall, E.C. "Recent Developments of the Society of Chemical Industry in Basle," by Dr. G. Engi. Also address by Dr. Henrich Schicht. 9 p.m. Lecture by Prof. R. V. Wheeler on "Dust Explosions," Home Office Industrial Museum, Westminster, S.W. 10 p.m. Visit to printing works of *Daily Mail*. WEDNESDAY, JULY 15. 10.30 a.m. Presentation of the Society's Medal to Dr. Herbert Levinstein, followed by an Address by the Medallist at Royal Academy of Music, Marylebone Road, N.W.1. 10.30 a.m. Tour by coach through London. 2 p.m. Works visits :—Wallpaper Manufacturing Co., Ltd. (A. Sanderson and Sons, Perivale); General Electric Research Laboratories at Wembley; Achille Serre, Ltd., Walthamstow; British Drug Houses, Ltd., Graham Street, E.C.; South Metropolitan Gas Co., East Greenwich; Mortlake Brewery of Watney, Combe, Reid and Co., Ltd. 7.30 p.m. Annual Dinner, Great Central Hotel. Limited to 600 Members of the Society. No lady guests. 6.30 p.m. Dinner for ladies at Madame Tussaud's, followed by visit to cinema. THURSDAY, JULY 16. 9.30 a.m. All-day visit to Agricultural Research Station, Rothamsted. 10.30 a.m. Addresses will be given in Leathersellers' Hall, E.C. 10.30 a.m. Meeting for reading and discussing papers presented by overseas Members, Regent Room, Great Central Hotel. 10.30 a.m. Meeting for discussing papers published in the Journal

of July 3, Marylebone Room, Great Central Hotel. 10.45 a.m. Tour by coach through London. 12.30 p.m. Luncheon, Trocadero Restaurant, W., followed by visit to J. Lyons and Co., Ltd., Cadby Hall, W., and Greenford factory. 2 p.m. Works visit:—National Physical Laboratory and Chemical Research Laboratory, Teddington; The Distillers Co., Ltd.; Burroughs Wellcome and Co., Dartford; Pyrene Co., Brentford and Firestone Tyre and Rubber Co., Brentford; Fuel Research station, Greenwich. 8.30 p.m. Reception by the President and Lady McGowan, Savoy Hotel, W.C. FRIDAY, JULY 17. All-day excursions:—9.15 a.m. Huntley and Palmer's Biscuit Factory, Reading; 9 a.m. Research Station of Anglo-Persian Oil Co., Sunbury-on-Thames; 9 a.m. Windsor Castle, Eton College, and then by river to Bourne End. 8.30 p.m. Reception and Dance, Imperial Chemical House, Millbank, S.W. SATURDAY, JULY 18. 9 a.m. All-day excursion to Oxford. SUNDAY, JULY 19. 10.30 a.m. Service, at St. Paul's Cathredral. 2.30 p.m. Visit Hampton Court. 3 p.m. Visit to the Zoo.

PRAGUE SUMMER SCHOOL.

July 20—August 8, at the Prague Summer School, during the long vacation there will be delivered lectures in English in a number of subjects including Literature, Art and Science in Czechoslovakia, the History and Geography of Central Europe, and there will also be language courses in German, Czechoslovak and Russian.

Particulars of the fees for one, two or three weeks, reduced railway fares and other facilities and excursions in connection with the course may be obtained from Dr. B. Trnka, 55, Smetana Square, Prague, Czechoslovakia.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

13,913.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of disulphides from mercapto compounds. May 11.

13,914.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 3-hydroxythionaphthene-7-carboxylic acid chlorides, etc. May 11.

14,417.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of carbyl sulphate, ethionic acid, etc. May 15.

Specifications Published.

348,140.—Compagnie De Bethune.—Barbituric acid derivatives.

348,037.—I. G. Farbenindustrie Akt.-Ges. Manufacture of alkoxy-benzophenone di- and tricarboxylic acids.

348,214.—Cahn, Dr. F. J.—Manufacture of organic acids.

348,255.—Imperial Chemical Industrie, Ltd.—Manufacture or prodnction of alkali salts of organic acids.

348,382.—Mannich, C.—Process for the manufacture of amino aldehydes.

Abstract Published.

343,881.—Acetylene and other unsaturated hydrocarbons; chlorinated hydrocarbons. Imperial Chemical Industries, Ltd., Millbank. London, and Binnie, D., Winnington Hall, Northwich, Cheshire.

The production of acetylene and other unsaturated hydrocarbons by the pyrolysis of normally gaseous hydrocarbons, especially methane and its next higher homologues, is effected at a temperature above 1000° C. and at a high space velocity in the presence of at least an equal volume of a gaseous or vaporised water-soluble diluent, other than steam. Hydrogen chloride is the preferred diluent, and when this is used at relatively high temperatures, chlorinated hydrocarbons may also be obtained. An example is given in which a mixture of equal volumes of methane and hydrogen chloride is treated.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

SCHWESOL.

522,183.—Colloidal sulphur, being a chemical substance for use in manufactures. — Einstein's electro Chemical Process, Ltd., 3, Central Buildings, Westminster, London, S.W.1. May 20.

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ECONOMIC ASPECTS OF THE PROPOSED AUSTRO-GERMAN CUSTOMS UNION.

Considerable attention has been directed to the various aspects of the recently proposed Austro-German Customs Union, but it is still doubtful whether the economic aspects and all the industrial implications are yet fully understood or appreciated. In the *Chemical News* for May 15, (this Vol. p. 312) reference was made to a publication by DR. E. BENES, the Czechoslovak Foreign Minister, entitled *The Austro-German Customs Project.* Now the same publishers (" Orbis," Pragne) have issued two further works on other aspects of the same question, namely, *The Economic Aspect of the Austro-German Customs Union* (ARGUS), pp. 85, price 1s.; and *Austria and the Customs Union* (M. BITTERMAN), pp. 118, price 1s. 6d.

The Austro-German agreement stipulates for a mutual adaption between Austria and Germany in regard to customs duties and trade policy (Vertrag zur Angleichung der zoll- und handelspolitischen Verhältnisse). The result of this " adaptation " would be that Austria and Germany would levy identical customs duties on goods imported from other countries, and that they would also introduce uniform regulations (such as portation of goods). At present there is a considerable discrepancy in many items of the Customs Tariff between German and Austrian duties. It is difficult to foresee how this "adaptation " of industrial duties, which include a great number of items, would be carried out. On the other hand it is comparatively easy to imagine what this adaptation would mean in the case of agricultural duties, especially in the case of duties on grain. At present there is a great discrepancy between Austrian and German duties on grain. German duties on grain are much higher than Austrian, in fact they are the highest in Europe. This fact is clearly revealed in the tables, published by the International Institute of Agriculture in Rome, showing the actually valid duties in various countries at the end of February, 1931.

For instance the German duty on wheat amounted to Mks. 25-, *i.e.*, fonrteen times as much as the Austrian duty on wheat (2 gold K for 100 kg.) German duties on other kinds of grain and flour are equally much higher than the corresponding Austrian duties.

It appears almost impossible that Germany would be willing to reduce her corn duties in consequence of the Customs Union, as the whole German agricultural production relies on them. Any reduction of these duties would surely meet with violent opposition on the part of the powerful agrarian political parties in Germany. How powerful this political influence of the agrarians, led by the Minister of Agriculture, Schiele, is, may be seen from the fact that the present Brüning Government is, according to a special law, able to raise agricultural duties without consulting Parliament to any degree according to the conditions prevailing in the market, so that German agriculture cannot be taken by surprise by any untoward developments in the world market. In no other constitutional country has the Government powers of such far-reaching economic import. These increasing protectionist tendencies found an expression in the new rise of duties on certain agricultural products which came into force on the 1st of May, 1931, after a serious conflict of opinion in the German Cabinet, for it was pointed out how inopportune it would be, at a time when wages were being reduced and unemployed increasing, to raise the cost of living. Despite this a series of agricultural duties were raised, as, for example, that on oats to 15 Mk, on live pigs to 40 Mk and on peas to 20 Mk.

Austrian imports from Germany amount to 21 per cent. of the total Austrian imports. These imports consist mostly of manufactured goods, which are subject to higher duties than other goods. It may be therefore assumed that the quota from the total revenue from customs duties, due to imports of German goods, is higher than 21 per cent. It amounts probably to 25 or 30 per cent. of the total revenue, *i.e.*, from 70 to 84 mill. Schillings. Even if we take into consideration the most favourable case of a complete abolition of duties between Germany and Austria, the burden of taxation through customs duties would decrease from the present 284 mill. Schillings to about 200 mill. Schillings, borne at present by the imports to Austria from other countries than Germany.

The published scheme does not mention the possibility of a union of the railway systems of Germany and Austria. Nevertheless such a *transport union* would only be a logical and natural consequence of the Customs Union. Through a well planned railway tariff policy Germany in union with Austria could raise serious obstacles in the way of all goods coming from States that would not join the union. A discrimination between the treatment of foreign goods and home goods is easily possible by means of such a tariff policy. It would also be possible to transport goods by a roundabout way instead of by the shortest and direct way used hitherto, in order to promote traffic on the home railway system to the detriment of the railway systems of other countries. Thus for instance goods sent from Saxony to Austria could go via Bavaria instead of via Bohemia. Goods from the Rhineland destined for Italy could be directed via the Brenner Pass instead of through Switzerland as hitherto, which would seriously affect the Swiss transit traffic.

Another consequence of this railway tariff policy would be the promotion of all trade via Hamburg. This would seriously affect Trieste, which is the natural and nearest seaport of Austria, for even Austrian goods would be exported via Hamburg and overseas goods would also go to Austria through Hamburg. Special transport facilities would enable German coal from the Ruhr district to compete successfully in the Austrian market with Czechoslovak and Polish coal. The present more or less normal and natural competitive conditions would be replaced by new conditions, through which by artificial means even distant competitors (for instance coal mines) within the boundaries of the Union would be favoured at the expense of nearer situated and more natural suppliers of the Austrian market outside the frontiers of the said Union. It would surely be no economic advantage for Europe as a whole, if goods bought and sold would have to be transported by longer, roundabout routes, and if the natural transport conditions would be disturbed by artificial means. For protectionist reasons the Union could offer cheap freights for the transport of home goods over long distances and charge high freights for the transport of foreign goods over short distances.

One of the fundamental conditions of closer economic collaboration of European nations is surely a certain stability in commercial policy, assured by satisfactory long term commercial treaties, as well as a binding stability in transport questions, which could form a guarantee against protectionist tendencies in transport policy. These ten-

dencies may find a far more effective expression in railway tariff discrimination than in customs duties, especially in the case of heavy goods, such as coal. These fears are not of a purely theoretical nature. Protectionism by means of freight policy is being practised in many countries, and it forms also part of the programme of the economic union of Germany with Austria.

The above reflections afford us an insight at least into some of the effects of the projected scheme of the Austro-German Customs Union, which may be summed up as follows :

(1) The adaptation (Angleichung) of the Austrian customs tariff system to that of Germany, and especially the raising of the present duties on grain in Austria to the level of those of Germany, will mean an increased handicap for goods imported to Austria. The increase of the customs duties levied on Austrian imports from other countries than from Austria would be much larger than the decrease due to the abolition or reduction of duties between Germany and Austria.

(2) A large part of the goods, supplied hitherto to Austria by other countries than by Germany, would in future be supplied by Germany. In a united customs territory, in which German goods could enter Austria duty free or at low internal duties, Germany could easily compete with other countries, handicapped by the high Austrian or German duties. Thus Germany could supplant other countries by supplying Austria with rye, oats, coal, machinery and all kinds of manufactured goods, hitherto bought from them. This exclusion of Austria from the existing trade system would mean the creation of further serious obstacles to European rapprochement.

(3) The introduction of the strict German veterinary regulations in Austria and other administrative protective measures which could be more easily carried into effect in a Customs Union, would constitute another series of protectionist measures, hampering the free exchange of goods in Central Europe.

(4) An organic and necessary result of the Customs Union would be the creation of a united Austro-German transport system, forming a further important point of the economic Anschluss programme. It is therefore necessary to take into account also the effects of this transport union, although it is not mentioned in the scheme published on March 20th. The direction of this transport union in the protectionist interests of Germany would create serious dislocations in European markets to the detriment of all European nations.

In his volume, M. Bitterman is concerned primarily with the crisis in Austria and his views have since received increased significance through the difficulties of the Kreditanstalt. He fears that the projected customs union would seriously affect Austria's trade balance and cites the chemical and metallurgical industries as ones most likely to suffer as a consequence of any union which would bring them in direct competition with their more powerful German rivals.

After a thorough examination of the question he also concludes that the proposed customs union would be no solution of the present economic difficulties of the countries concerned and would seriously upset international trade.

CHEMICAL FOG IN WAR.

An interesting experiment in the protection of communities from air attacks has just been carried out near Lille, in the presence of Marshal Petain, French Inspector-General of Aerial Defence.

The problem is that any important centre should in case of an anticipated attack be hidden under a cloak of artificial fog. With aeroplanes soaring above in order to observe results of the test, the military and naval experts stood on a small platform beside the fog-creating apparatus. This discharged a thick blanket of mist which, with the wind blowing at the rate of 15 yards a second, soon covered the whole village. Observers of the test have reported that the village was perfectly invisible from the air. The fog screen is described as quite harmless to those it envelops, although they experienced a slight irritation of the throat and nostrils.

There could be no more vital development for future war than that of an artificial substitute for the cloak uncertainly provided by Nature. Smoke screens laid by artillery or tanks are now in common use, but they are too small and too local. They may blind the defenders of a certain position, but they do not create the chance of a dramatic and far-reaching surprise.

WHERE TO LOOK FOR EKA-CAESIUM.

By H. H. Stephenson.

Of the 92 elements postulated by Moseley and contemporary theory, only one, No. 89, usually known as eka-cæsium, has had no claim made to its discovery. It is possible that the element is so radioactive that it decomposes almost as soon as it is formed; but it may be that eka-cæsium has not been discovered simply by reason of its scarcity or of some peculiar property.

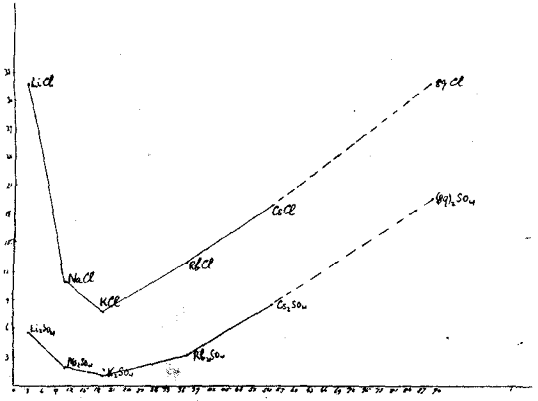
A glance at the family of alkali metals, to which No. 89 belongs, shows that there is likelihood of such a property, *viz.*, an extremely high solubility. The molecular percentage solubility (gm.-mol. per 100 gm.-mol. of water=1,800 c.c. of water) of the salts of the alkali metals is shown in the graph and in the following table (tem. 15° C.).

At. No.	Element	Graph RCl	R_2SO_4
3	Li	31.9	5.7
11	Na	11.0	1.7
19	K	7.8	1.1
37	Rb	13.0	3.1
55	Cs	19.3	8.7

Potassium the lowest solubility, being in the middle of the family; the end-members have the highest solubility. Extrapolating, eka-Cs has a molecular solubility of at least 32, which is 221 gms. per 100 c.c.

These figures make it reasonably certain that whatever eka-cæsium exists is in the sea. It may be uniformly diffused or it may be localised. In the former case, to detect it in any average sample of sea-water is simply a matter of increasing analytical skill. The alternative, however, seems more probable. The sea, in spite of surface commotion, is, taking it in bulk and with due regard to proportion, a very still liquid. A dense solution would in course of time tend to find the bottom, and being moved sluggishly along by the floor current which flows from the Southern to the Northern hemisphere, would sink yet further as occasion arose into those "deeps" which we know exist in various parts of the ocean. Once there, further travel would be unlikely, and in the case of the element we are considering, its high solubility would prevent it from crystallising.

If we may be allowed, therefore, an "intelligent guess," it is that eka-cæsium will probably be found in samples taken under favourable conditions from the real deeps, such as Mindanao, off the Phillipines.



COMBINED STEAM POWER AND HEATING.

A Noteworthy Paper Dealing with Costs of Electrical Generation.

By A Well Known Engineer.

There has now been published an important contribution by E. G. Phillips read recently before the Institution of Heating and Ventilating Engineers, entitled "The Cost of Operating Industrial and Private Electric Generating Sets Compared with Public Supply." This emphasises in lucid fashion the fact that in any industrial or other establishment requiring process steam, such as a chemical works, electricity can be generated at far less cost by using a back pressure engine or turbine, as compared with the purchase of electricity from a power station having condensing steam turbines with 55-60 per cent. of the total heat in the coal lost in the cooling water. Generally for this reason the actual thermal efficiency does not exceed 20 per cent., and consequently electricity cannot be purchased from a power station by the great majority of users in Great Britain for example at much less than 1.25d. per unit for power purposes. Thus the average cost of production, as given by Mr. Phillips, is about 0.70d. per K.W. for works costs alone, that is 0.20d. per K.W. for coal, 0.80d. wages, 0.025d. stores and oil, 0.180d. repairs and maintenance, 0.150d. rent, rates, and taxes, and 0.087d. management, totalling 0.722d. Obviously, therefore, when interest on capital profits, distribution charges and other items are included it is not possible for the total figure to be much less than 1.25d. per unit. Thus an average of 14 large power station undertakings in Great Britain is 0.595d. for works costs and 1.235d. selling price, and for the whole country the figures are higher. But in the case of the individual establishment when using combined power and heating, with all the low pressure steam used for heating, the total cost of electricity for the user is only about 0.25-0.50d.

The paper contains several detailed examples of the great economies being obtained on these lines, one of which is a works requiring an average of 50,000 lbs. of process steam per hour and also 400 K.W. for power, as well as a smaller amount for lighting. This current was purchased at an average of 1.95d. per unit, being 1.25d. for power, and 5.00d. for lighting, normal prices in Great Britain. Then a combined steam power and heating plant was installed, consisting of two 250 K.W. back-pressure engine sets operating at 190 lbs. per sq. in. pressure at the top valve and exhausting at 35 lbs. Allowing ample figures for interest, depreciation, oil, repairs, maintenance, radiation losses and other items, the same amount of low pressure steam is given as before along with the electricity required at a cost of 0.25d. per K.W.h, inclusive for both power and lighting. This corresponds to a saving of £5,700 per annum, the load being approximately 700,000 K.W.h. per annum, while the capital cost of the whole plant was only £4,000.

There are of course a very large number of plants of this general character operating with great success all over the world, and Belliss and Morcom, Ltd., of Birmingham, for example, one of the chief pioneers in this field, have supplied nearly 1,500 installations during the past 30 years, back pressure and pass-out engines and turbines at work in most countries of the world. Further the paper contains a Table showing the approximate B.H.P. available in 10,000 lbs. of steam per hour when supplied to a back pressure engine or turbine and exhausted under different pressure conditions. For example, a standard "Lancashire" boiler 30′ 0″ × 9′ 0″ operating at 150 lbs. pressure with an evaporation of 10,000 lbs. per hour and exhausting 5 lbs. pressure from the engine will generate 410 H.P., while the extra amount of coal required to generate steam at 150 lbs. pressure instead of 5 lbs. is of a trifling character because of the small difference in the total heat of steam under the respective conditions.

CHEMICAL WORKERS' WAGES.

The members of the National Union of Drug and Chemical Workers by a ballot have decided by a majority of four to one to support their union's new agreement terms and to stop work on June 22nd. By a majority of three to one they favour a stoppage on June 22nd, to maintain existing terms. The employers had put forward a new agreement, but the workers have decided against it by a majority of 30 to one. For further negotiations for better terms there was a majority in favour of 10 to one.

INSTITUTION OF GAS ENGINEERS.

68TH ANNUAL MEETING.

The Annual meeting of the Institution of Gas Engineers which opened on the 3 June, also marked the occasion of the First International Gas Conference. Delegates attended from Australia, Japan, Belgium, Brazil, Sweden, Canada, Ceylon, British West Indies, South Africa, U.S.A., Yugoslavia, France, Germany, Czechoslovakia, Hungary, Holland, Norway, Malta, Switzerland and Uruguay.

Early in the proceedings the four medals awarded by the British organization were presented to the following :—

Birmingham Medal, 1931, to Mr. Thomas Hardie, chief engineer of the Gas Light and Coke Company, for his work on behalf of the industry; the H. E. Jones London Medal, 1930, to Mr. Edward G. Stewart, of London, for his paper on "The Functions of Coke Ovens"; the Institution's silver medal, 1930, to Mr. A. L. Holton, chief engineer, Manchester Gas Corporation, for his paper on "The Utilisation of Coke Breeze by the Trefois Process"; and the Institution's bronze medal, 1930, to Mr. S. K. Hawthorn, Birmingham, for his paper on "Oxide Purification."

Mr. Harold Ernest Copp, engineer and manager of the Hull station of the British Gas Light Company, in his presidential address, said the conference was the first to be held under the statutes of the International Gas Union (Union Internationale de l'Industrie du Gaz), the inauguration of which he hoped it would be his privilege to announce at the session for international business. Referring to the Report on the Industrial Situation issued by the National Confederation of Employers' Organizations in February, Mr. Copp said the figures showing the relative costs of national taxation, wage levels, and social services in Britain, France, Germany, Belgium, and Italy demand very serious attention. In principle he was definitely opposed to any lowering of the standard of living, for he believed that in its maintenance lay the highway to national prosperity and contentment. The standard, however, could only be upheld so long as industry was capable of paying for it, and that, in turn, was dependent upon industry's ability to pay reasonable dividends, so that the necessary capital might be attracted, business and enterprise encouraged, and command of markets of the world be retained. There was no doubt that relatively too much was paid for some classes of work and too little for others.

Some amount of rationalisation had taken place in the gas industry in recent years by many small undertakings amalgamating with large ones, but there were limitations to such amalgamations, since the economies in manufacture must not be exceeded by the added costs of distribution. Another objection to rationalisation was that it tended to eliminate personal contact between employers and employees.

He agreed with those who held that there was great need for the further improvement of gas lighting appliances. Although much had been done to increase efficiencies by preheating, still better results would be obtained if more of the waste heat could be imparted to the secondary air necessary for complete combustion.

GAS AND ELECTRICITY.

There was a popular belief that the gas industry was necessarily opposed to the principle of low-temperature carbonisation. There could be nothing further from the truth. In face of the intensive campaign launched by the electrical industry with the aid of Government finance and newspaper publicity, he would stress to the utmost that those engaged in the gas industry were called upon for greater individual and collective effort. They had a good case, based upon scientific and economic grounds, in that they were able to transform some 85 per cent. of the available energy contained in their raw material into gaseous and solid fuel and products, whereas the electrical industry fell far behind from the points of view of economy and the conservation of our national fuel resources.

WOOL TEXTILE WAGES.

The organized employers' federations in the West Riding wool textile industry held a joint meeting of their members yesterday, at which it was recommended that wages be reduced 5 per cent. on the basic rate and the cost-of-living bonus adjusted to the present level compared with pre-War, making a total reduction of 14.6 per cent., to be made in two instalments. The various federations will now consider the recommendations.

THE ITALIAN COURT OF CASSATION RECOGNISES THE JURISDICTIONAL IMMUNITY OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE.

An important judgment concerning the relations of the International Institute of Agriculture with its functionaries has just been issued by the Italian Court of Cassation which met in full session under the Presidency of its first President, His Excellence d'Amelio and in the presence of the Attorney General His Excellence Longhi. The judgment was drafted by Mr. Justice Andrea Ferrara. The court was called upon to decide whether in its relations with its functionaries the International Institute of Agriculture is subject to the jurisdiction of the Italian judicial authorities. The Courts accepted the view sustained by the authorities of the International Institute of Agriculture as expounded by Prof. Prospero Fedozzi of the University of Genoa and Prof. Givoranni Carrara of the University of Rome and declared that the Iitalian Government has no jurisdiction over the Institute. The Court, on the basis of the Convention of the Institute, laid down that the International Institute of Agriculture is an international administrative Union, entirely autonomous and impervious to the penetration of the Sovereign Power of Italy as of all other States belonging to the Union. Hence its power of self-determination and autonomy, which includes that of organising its own administration, eliminates all interference and penetration by the laws of the various States whether of substance or procedure. If it is true according to the decision of the Court, that the jurdical organisation of the International Institute of Agriculture is not furnished with a body of its own to decide controversies arising between the Institute and its functionaries it may also be affirmed that this omission is to be easily explained by doubts previously entertained as to the legality of the jurisdiction of the Italian Courts over such disputes. Any doubts of this kind have now been removed as a result of the diplomatic immunities recently granted by the Italian Government to the Delegates and higher functionaries of the Institute in the exercise of activities connected with their respective public functions and the Institute will, it may be assumed, proceed to establish its own administrative court on the lines of that set up by the League of Nations which obtained diplomatic immunity for its functionaries at the date of its constitution.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

APPLICATIONS FOR LICENCES IN MAY, 1931.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during April has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 511, of which 429 were from merchants or importers. To these should be added 6 cases outstanding on the 30th April, making a total for the month of 517. These were dealt with as follows :—

Granted—481 (of which 474 were dealt with within 7 days of receipt.)

Referred to British makers of similar products—25 (of which 24 were dealt with within 7 days of receipt).

Outstanding on 31st May—11.

Of the total of 517 applications received, 498 or 96 per cent., were dealt with within 7 days of receipt.

SULPHURIC ACID AND ARSENIC PRODUCTION IN CANADA.

The production of 66 degree Beaumé sulphuric acid in Canada last year totalled 107,352 tons valued at $1,347,525 at the works as compared with 110,749 tons worth $1,375,599 in 1929. Exports of sulphuric acid from Canada amounted to 570 tons worth $6,530 in 1930 as against 8,397 tons worth $97,634 in the previous year; practically all of the acid was shipped to the United States. Imports totalled only 149 tons worth $13,612 in 1930 and 111 tons at $10,287 in 1929.

Only 8 plants in Canada made sulphuric acid in 1930. These concerns used 8,241 tons of pyrites and 20,233 tons of sulphur, while three made sulphuric acid from waste smelter gases.

The production of arsenic in Canada in 1930 is reported by the Dominion Bureau of Statistics to have reached a total of 4,524,220 pounds valued at $129,527. Of this, white arsenic accounted for 2,750,680 pounds and the content of arsenical concentrates and residues exported is reckoned at 1,773,540 pounds.

POISONS BILL.

PROFESSOR H. R. KENWOOD'S STATEMENT IN FAVOUR OF THE MEASURE.

Dr. H. R. Kenwood, Emeritus Professor of Public Health, London University, past-president of the Society of Medical Officers of Health ,and widely known as a public health expert, has issued a statement giving his support to the Pharmacy and Poisons Bill which is about to be discussed on the second reading in the House of Commons.

" From the public health point of view this is an important Bill," Professor Kenwood said. " There is a great deal of loose thinking upon the Bill for in the public mind there is a disposition to think of it as relating only to such substances as arsenic, phosphorus, strychnine, etc., and to lose sight of the fact that it includes a great number of substances, containing some poisonous element, which are of great service in administering to the industrial and social needs of the community, and for which there is a great market.

"These latter are included in Part II of the Bill. It is important that they should be made as available to the public as possible and it is indeed in the public interest that this should be so.

" To give an illustration : the old Act tended to promote the sale of inefficient disinfecting agents, general dealers being forbidden to sell any but those possessing very weak disinfecting powers, the sale of the more efficient agents being a monopoly of the pharmacists.

" The effect has been that the tradesman to whom the bulk of the public goes for disinfectants is allowed to sell only those which are least effective in preventing the spread of infectious diseases, such as influenza; yet when really efficient and properly employed, disinfectants are important aids to preventive medicine.

" There is no case ,apart from the financial interests of one section of trade, for restricting the sale of any such products to the pharmaceutical chemists, for no poison book has to be signed for them and no protection whatever is secured to the public. It is to be hoped that in the public interest nothing of this nature will be introduced to what is a very useful measure in the form in which it left the House of Lords."

PROFESSOR PICCARD'S BALLOON ASCENT.

Communicated by our Special Correspondent.

Augsburg. June 3rd.

Professor Piccard and his assistant, Dr. Kipfer, flew from here to-day to Zürich, where the Professor is breaking his journey in order to lecture this evening. From Zürich he intends to travel to Brussels.

Upon arrival of the balloon and Professor's instruments, a careful examination was made at the Riedinger balloon works, and the cause of the scientist's difficulties appeared to be the twisting of the valve rope, the valve itself being found to respond without fault.

Professor Piccard announced his intention of returning in the fall of the year to undertake further balloon investigations, intending though on this ascent to confine his researches to lower atmospheres.

ORDER OF MERIT FOR SIR WILLIAM BRAGG.

Sir William Bragg, F.R.S., who is director of the Royal Institution, has been continuously engaged for more than a quarter of a century in researches into the rays from radio-active bodies, has now received the Order of Merit. An earlier unique distinction also fell to his family in 1915, when the Nobel Prize for Physics was awarded jointly to Sir William and his son, Prof. W. L. Bragg, for their work on the nature of crystals. Sir William was president of the British Association in 1928. He was recently given the Franklin Gold Medal, the highest award of the Franklin Institute of America.

Many of his lectures and addresses have been published in *The Chemical News.*

Dr. Albert Mansbridge, adult and technical educationist has had the Companionship of Honour conferred upon him on the occasion of the King's birthday.

SIR FREDERICK KENYON HONOURED.

On Wednesday, the 3rd June, the Honorary Freedom and Livery of the Worshipful Company of Stationers was presented to Sir Frederick Kenyon, until recently Director and Principal Librarian of the British Museum.

GENERAL NOTES

RADIUM DEVELOPMENT IN ONTARIO.

The Ontario Radium Corporation, Limited, now developing a deposit of radioactive ore on its property near Wilberforce, Ontario, has submitted a 32-ton sample of the material to the Ore Dressing and Metallurgical Laboratories of the Department of Mines at Ottawa for analysis, and the results attending its examination there have encouraged the Company to continue development work.

Previous work had been confined to surface exploration by stripping, trenching and sinking of pits at intervals along the strike of the deposit over a distance of 1,500 feet and on the northwest margin of a steep hill.

At a point on the hillside at a vertical depth of 60 feet below the surface of the deposit, a tunnel is being driven to intersect the ore. To reach this objective it is estimated from the dip of the deposit, that the tunnel will require to be driven from 180 to 200 feet from the mouth. The tunnel has been advanced to a point 124 feet from the mouth and two veins parallel to that opened up on the top of the hill, has been cut, one of these being two feet and the other three feet in width, and both carrying uraninite and that from the second vein to the the then face, the rock is well mineralised calcite, fluorite, iron, feldspar, etc. (the associated dike minerals of the uraninite) being all mixed together.

In the samples from the second vein received at the Company's head office, the uraninite is fresher and more plentifully distributed in the gangue material than was the case at the surface showing.

The tunnel is being advanced over five feet per day one drill working single shift. Upon completion of the tunnel, the deposit will be drifted on east and west and it is confidently expected that a large tonnage of commercial ore will be blocked out.

CZECHOSLOVAKIA'S EXPORTS TO BRITAIN.

Although the volume of Czechoslovakia's trade with England last year showed a restriction of 27 million crowns, compared with 1929, the balance in Czechoslovakia's favour was 138 millions higher, in spite of a drop in sugar exports of 24 million crowns. This result was chiefly due to a falling off in imports from England by 230 million crowns, exports from Czechoslovakia being only 47 millions smaller.

Imports of the leading commodities registered considerable losses, cotton and wool yarns and manufactures being most affected; the value of machinery was almost halved. A minor rise occurred in imports of electrical machinery and appliances. provisions, paper and paper goods, Colonial produce, glass and glassware, furs and porcelain.

Exports from Czechoslovakia to England, on the other hand, showed increases in cotton yarns and fabrics from 190 to 207 million crowns, in leather and leather goods from 81 to 116 millions, in silk and silken goods from 49 to 54 millions, in rubber and rubber goods from 2.6 to 24 millions, and in electrical machinery from 12.7 to 20 million crowns. Declines occurred in iron and hardware, woollen goods, clothing and glass.

CITY LIGHTS.

Experts' Midnight Tour of London's 100,000 Gas Lamps.

Over three hundred of the delegates, representing sixteen different countries, attending the first International Gas Conference, made a tour of London in the early hours of last Thursday morning to see the City's lights.

The procession of charabancs left Pall Mall at 11 p.m., and crossed Vauxhall Bridge to view the world's latest types of overhead high-pressure gas lighting, which have been installed along the main roads to the south coast in Camberwell, Blackheath and Lewisham.

The delegates returned by way of Old Kent Road to Blackfriars and crossing the Thames, visited St. Paul's, Fleet Street, Marble Arch and Oxford Street, returning to Victoria at one o'clock.

The visitors learned that there are over 100,000 street gas-lamps in London and that most of the principal thoroughfares, the Houses of Parliament, Buckingham Palace and the bridges across the Thames are all lit by gas.

Technical data relating to the various installations on the route had been specially prepared by the South Metropolitan Gas Company, in conjunction with the Gas, Light and Coke Company, and were supplied to every delegate.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, June 4.

The Croonian Lecture, on *The Messages in Sensory Nerve Fibres and Their Interpretation.* By PROFESSOR E. D. ADRIAN, F.R.S.

By amplifying the electric changes which take place in the individual nerve fibres it is possible to record the messages which pass from the sense organs to the central nervous system and from the motor nerve cells to the muscles. It is found that a series of brief potential changes travel along each nerve fibre; the changes are of fixed intensity and duration but their frequency varies with the intensity of the excitation. Each potential change represents a nerve impulse of the type made familiar by the classical methods of electro-physiology. Reasons are given for the belief that all nervous communication is carried out by such impulse messages and that the impulses, like the electric changes which accompany them, are unaffected by variations in the intensity of the stimulus. The general similarity of motor and sensory messages makes it probable that the sensory nerve endings and the synoptic regions of the central nervous system work on a common plan depending on the fundamental properties of exeitable cells.

The sensory messages which have been most thoroughly investigated are those produced by the muscle spindles. Those from the skin receptors are less easy to analyse but are of greater interest to the physiology of sensation. At present the most definite results have been obtained from the frog. The frog's skin contains receptors which respond to light contact with a brief discharge of impulses travelling in nerve fibres which conduct rapidly. A vibrating stimulus gives a series of impulses with the same frequency as that of the stimulus, but discharges of high frequency and long duration from these receptors do not give rise to pain. Firm pressure at certain points gives a continued discharge of rapid impulses with a declining frequency. The receptors probably differ from those responding to light touch though both are in superficial layers of the skin. Stimuli which would be likely to cause continued pain give rise to impulses of small action potential travelling in fibres which conduct very slowly (about 1 metre a second).

In the mammal, as in the frog, light touch produces a brief discharge of impulses of large potential conducted rapidly, and firm pressure gives a coutinued discharge. Impulses of smaller potential conducted at slower rates are produced by movement of the skin and persistent discharges often arise from exposed tissues. At present it appears that some of these impulses are caused by stimuli which wonld not necessarily be painful.

A comparison of these results with those of Gassa and Erlanger and of Piéton shows that the nerve fibres responsible for pain are not all of the same type, though they are all of smaller diameter than the tactile fibres. It is suggested that the rate of reaction and amount of conveyance in the sensory pathways are important factors in determining the intensity of sensation, since this must depend on a summation of the effects of discontinuous impulses.

THE CHEMICAL SOCIETY.

Thursday, June 4.

Synthesis of Substances Analogous to Bile Acid Degradation Products. Part 1. Preliminary Investigation of Methods of Attachment of Carboxylated Side-Chains to the cyclo*pentane Nucleus.* By J. W. BAKER.

Attack on the problem of the structures of the *cyclo*pentane acids $C_{16}H_{24}O_8$ and $C_{13}H_2''O_6$, obtained by oxidative degradation of deoxybilianic acid (Wieland and Vocke, *Z. physiol. Chem.*, 1928, CLXXVII, 68; 1930, CXCI, 68) has been initiated from the synthetic standpoint, and preliminary experiments on the attachment of the side-chains $.CHMe.CO_2H$, $.CHMe.[CH_2]_2.CO_2H$, and $.CH(CO_2H).CH_2.CO_2H$, to the *cyclo*pentane nucleus are described. The ketonic ester obtained by a Diecymann condensation from ethyl β-methylbutane-$\alpha\beta\delta$-tricarboxylate (Ruzicka, *Ber.*, 1917, L., 1362) has been shown, by oxidation, to be ethyl 3-methyl*cyclo*pentanone-2 :3 dicarboxylate (I). Ethylation of this ester affords *ethyl 3-methyl-2-ethyl*cyclo*pentanone-2 : 3-dicarboxylate* (giving a crystalline *hydrazone-dihydrazide*, and hydrolysed to γ-*methyl*-n-*hexane-$\alpha\gamma\delta$-tricarboxylic* acid) which contains the arrangement of alkyl and carboxyl groups present in one of the possible structures for the C_{13} acid, together with a reactive carbonyl group at the desired point

of attachment of the side-chain. Although introduction of the side-chain .CHMe.CO_2H has not yet been effected, ethyl dimethylacetoacetate has been converted, successively, into *ethyl β-hydroxy-ααα'β-tetramethylglutarate*, *ααβγ - tetramethylglutaconic acid*, and *αα'β-tetramethylglutanic acid*, the last of which is an open chain analogue of the required *cyclo*pentane acid. Attachment of the side-chain .CHMe.$[CH]_2$.CO_2H has not yet been achieved, but the .$CH(CO_2H)$.CH_2.CO_2H side-chain has been successfully introduced by condensation of the sodio-derivative of ethyl *cyclo*pentanone-2-carboxylate with ethyl bromosuccinate to give *ethyl 2-carboxy-1-keto*cyclo*pentyl-2-succinate*, hydrolysed to *keto*cyclo*pentyl-2-succinic acid*. Finally, the action of a large excess of magnesium phenyl bromide on I gives a crystalline pentaphenylated carbinol (or its internal ether) which may serve as a reference compound in the further degradation of the C_{13} acid.

Reactions of ω-Substituted Acetophenone Derivatives. Part I. The Action of Acetyl Nitrate on ω - Halogeno - m - nitroaceto - phenones. By J. W. Baker.

ω-Iodo-m-nitroacetophenone, prepared by the action of alcoholic potassium iodide on the corresponding ω-bromo-compound, is converted by a mixture of acetic anhydride and nitric acid (*d*1.52) at the ordinary temperature into *ω-iodo-mω-dinitroacetophenone*. This compound is decomposed immediately on exposure to air, iodine being evolved, but has been isolated for analysis and investigation in a specially devised piece of apparatus. With water it affords m-*nitrophenylglyoxal*, identical with a specimen synthesised by oxidation of *m*-nitro-phenacyl alcohol with aqueous copper acetate, and converted by oxidation into *m*-nitrobenzoylformic acid, m.p. 105°.

The Constitution and Synthesis of Embelic Acid (Embelin), the Active Principle of Embelia ribes. By K. Habib Hasan and E. Stedman.

Our chief knowledge of the chemistry of embelic acid is due to the work of Heffter and Feuerstein (*Arch. Pharm.*, 1900, CCXXXVIII, 15). It is a *p*-quinone, possesses two hydroxyl groups and yields, on oxidation, lauric acid. No proof was furnished for the existence of the methyl group. The presence in the formula of this group was rendered necessary as a result of the assumption that the carboxyl of the lauric acid was derived from the arhon ring. It is evident, however, that this acid might originate entirely from the side-chain, in which case the constitution of embelic acid would be expressed by formula II, which is in no way inconsistent with Hefter and Feuerstein's experimental results.

In view of the work of Kaul, Ray and Dutt (*J. Indian Chem. Soc.*, 1929, VI, 577), who state that they have identified the acid produced on oxidation of embelic acid as *iso*lauric acid, it became necessary to repeat this oxidation. As a result, Heffter and Feuerstein's work was confirmed, the acid obtained on oxidation of embelic acid with alkaline permanganate, the method employed by Heffter and Feuerstein, or by nitric acid, one of the methods used by Kaul, Ray and Dutt, being identified as n-lauric acid. Embelic acid is now also shown to be dihydroxylauryl-*p*-benzo-*quinone*.

THE PHYSICAL SOCIETY.

June 5, 1931.

The following papers were read :

Electro-Osmosis and Electrolytic Water-Transport. By H. C. Hepburn, Ph.D.

A new and convenient form of apparatus is described for the measurement of liquid-transport produced by the application of an electric field across a diaphragm of parchment paper. Results obtained with solutions of copper sulphate over the concentration range 0.0005-normal to 1-normal are compared with corresponding results obtained previously, by the author, by the use of a diaphragm of powdered glass. The liquid-transport per faraday with the parchment diaphragm decreases strongly with increasing concentration up to 0.2-normal, but maintains practically a constant value over the concentration range 0.4-normal to 1-normal. This value is compared with that deduced for the electrolytic water-transport per faraday from the values of the experimental Hittorf transport number; and evidence is adduced indicating that there is no increase in the electrolytic water-transport per faraday with decreasing concentration from 0.4-normal. The data for the solutions over the concentration range 0.0005-normal to 0.2-normal appear to be consistent with the hypothesis of a composite effect produced by a constant electrolytic water-transport per faraday (of the same magnitude as the observed transport per faraday over the concentration range 0.4-normal to 1-normal) and by a specific (electro-endosmotic)

action of the parchment diaphragm. The determination of electrolytic water-transport is utilized to correct the values of the experimental Hittorf transport number obtained from the data of Hittorf and Metalka. The true transport number in the case of copper sulphate solutions decreases with decreasing concentration from 1-normal, but the values at concentration 0.125-normal and less appear to be little different from that at infinite dilution.

Spectra of trebly and quadruply ionized antimony, Sb IV and Sb V. By J. S. Badami.

A study of the spark spectrum of antimony under varying conditions of excitation has led to an extension of the existing classification of the spectrum of Sb IV. Many new lines are classified as secondary members of the series. A second P term has been established for the Sb V spectrum.

A time base for the Cathode-Ray Oscillography of Irregularly Recurring Phenomena. By G. I. Finch, R. W. Sutton and A. E. Tooke.

An account is given of a linear neon-lamp time base by means of which cathode-ray oscillograph traces due to recurring electrical or magnetic phenomena can be accurately superimposed, even though the train frequency be subject to wide and irregular variations. The underlying principle of this time base lies in the use of a glowing neon lamp which is extinguished by energy furnished either by the phenomenon under investigation or by some other phenomenon associated therewith.

The Attenuation of Ultra-Short Radio Waves due to the Resistance of the Earth. By R. L. Smith-Rose, D.Sc., Ph.D., A.M.I.E.E., and J. S. McPetrie, B.Sc.

This paper describes an investigation of the attenuation of radio waves, of wave-lengths between 5 and 10 metres, when transmitted directly along the earth's surface. A brief description is given of the transmitters employed, one being a fixed installation used with an input power supply of the order of 500 watts, the other a transportable set operated with an input supply of about 50 watts obtained from batteries.

The observations of field-intensity were obtained hy measurement of the audio-frequency voltage across tbe telephones of a simple two-valve loop receiver, a brief description of which is given. Measurements were carried out at both Slough and Teddington of the field-intensity at various distances from the transmitter up to 700 metres. In some of the experiments a negative attenuation effect was observed in the radiated field over a distance of about 4 wave-lengths. Later measurements carried out under more favourable conditions did not show this effect, which was, therefore, attributed to the interference of waves reflected from trees and buildings in the neighbourhood of the transmitter. Some qualitative observations were made at distances up to 20 miles with a single-loop direction-finder. These observations showed that the signal intensity on such short wave-lengths depends to a great extent upon the existence of obstacles in the path of transmission. The signal-intensity at a distance of 20 miles over a direct air line was of the same order as that obtained at 4 miles for transmission along the ground.

A comparison has been made between the experimental results and those calculated from a simple wave-attenuation theory, the electrical constants of the earth being taken into account. As a result of this comparison, the value of the conductivity of the earth appears to lie between 5×10^8 and 30×10^8 e.s.u. for the frequencies of 30 to 60 megacycles per second employed. These values correspond to resistivities of from 1,800 to 300 ohm/cm^3. The most suitable value of the dielectric constant of the earth is about 10, although the experimental method does not enable this to be obtained with any great accuracy.

A brief description of some experiments carried out with a single-loop direction-finder on the wave-lengths under consideration is appended to the paper.

THE GEOLOGICAL SOCIETY.

May 20, 1931.

Prof. E. J. Garwood, M.A., Sc.D., F.R.S., President in the Chair.

The following communication was read:

The Geology of the Coutry between Ivybridge and Buckfastleigh, Devon. By Albert Alfred Fitch. B.Sc., A.R.C.S., F.G.S. (Read by Dr. A. Brammal, D.I.C., F.G.S.)

The area described consists of a strip of the granite margin, the metamorphic aureole, and some rocks beyond the influence of the granite.

Vesuchsanstalt in Vienna by Prof. Przi-

The physical geology is discussed, and the presence of a relic of the 700-750-foot platform demonstrated by planimetric measurements.

Stratigraphically, the rocks comprise

Carboniferous...D 3......Culm, with a sandstone band and an intrusive dolerite.

Devonian	Frasnian	Slates Limestone
	Givetian	Spilitic complex Slates.

The Devonian is folded into a syncline, while the Culm is present only in a trough-faulted block, which appears to include a slice across the southern margin of the granite, with the Culm included at both ends, where the two faults converge. The sequence and structure are cut across by the Dartmoor Granite, and the several rock-types undergo a varied suite of changes, controlled by the degree of thermal metamorphism, of pneumatolytic and hydrotheral action, and the original lithology. The petrology and petrogenesis of the resulting rocks are discussed in detail, and some aspects of two-way migration considered.

The mineral assemblage of the aureole is not of much diagnostic value for the provenance of the sediments of the South of England. Superficial deposits do not afford matter of great interest.

Economic aspects of the geology were dealt with.

June 3.

A Contribution to the Petrology of the Metamorphic Rocks of East Greenland. By JOHN DUGDALE HOLT WISEMAN, B.A. (Communicated by Dr. Alfred Harker, M.A., F.R.S., F.G.S.)

This paper deals with the petrology and genesis of the metamorphic rocks of East Greenland collected by the Cambridge Expedition of 1929 between latitudes 72° and 74° N.

Regionally metamorphosed igneous and sedimentary rocks are the characteristic rock types from both the Central Metamorphic Complex and the Musk-ox Fjord Inlier; unmetamorphosed igneous rocks are rare. The Franz Josef beds are structually above the Central Metamorphic Complex.

NOTICES OF BOOKS.

Elektrophorese, Elektro-osmose, Elektrodialyse in Flüssigkeiten. By Dr. P. H. PRAUSNITZ and Dr. J. REITSTOTTER. Pp. xii+307. Dresden and Leipzig: Theodor Steinkopff. 1931. Price 18 marks 50 pf.

Within recent year there has been a rapid development in the application of knowledge concerning the electro-technical phenomena of disperse systems. The authors of the present comprehensive volume have collected together an account of electrophoreses, electro-osmosis and electrodialysis, including both matter of purely scientific interest as well as information of technical importance. A valuable feature of the book is that portion (covering over a hundred pages) in which patents bearing on the application of electro-osmosis and electrodialysis in such industries as the drying of peat, clay, etc., water purification and in the separation of petroleum-water emulsions.

This detailed technical information is preceded by a careful description of the behaviour of colloidal solutions as electrolytes with complex ions. The phenomenon of electrophoresis in inorganic hydrosols and suspensions and and inorganic colloids and the authors direct attention at the end of this section to the similar nature of the electrolytic deposition of one metal upon another.

In the section dealing with electro-osmosis the factors of concentration, the nature of the diaphragm, temperature and viscosity are considered and reference is also made to electro-osmosis in non-aqueous solvents. The authors denote some space to recent developments in electro-dialysis which has made considerable progress since the introduction of two diaphragms into the system and has even been used in connection with ultra-filtration.

Connecting Laws in Animal Morphology. By PROF. HANS PRZIBRAM. Pp. 62. University of London Press, Warwick Lane, E.C. 1931. Price 4s. 6d.

The subject matter of the four lectures delivered some time ago at the University of London by Prof. Przibram of Vienna, has now been made permanent by the publication of this little volume on the *Connecting Laws in Animal Morphology.* The

text is fully illustrated with some 32 figures from photographs taken at the Biologische bram and his co-workers.

The particular branch of zoology treated here is still in its infancy. The generalisations in connection with the laws of animal morphology have mostly been based upon speculation. Only of late has the experimental method gained ground and have there been institutions adapted for its study.

Prof. Przibram is concerned with the correlation of the laws governing the processes of differentiation, growth, multiplication and modification in animals. He endeavours to trace each phenomenon to its source and to indicate its significance. His book will stimulate further efforts in this field.

"ECONOMIC CONDITIONS IN BELGIUM" IN 1930.

By THE COMMERCIAL SECRETARY TO THE BRITISH EMBASSY AT BRUSSELS.

Published for the Department of Overseas Trade by His Majesty's Stationery Office. Price 4s. 2d. Post free.

The Commercial Secretary points out in his Introductory Remarks that it would be idle to pretend that the economic situation of Belgium dnring the year 1930 was as prosperous as that revealed in the Report for 1929, and it is possible that the concluding paragraphs of the introductory remarks to that report were somewhat too optimistic.

Towards the close of 1929 some uneasiness was certainly shown in industrial circles in regard to the future prospects of the Belgian export trade, but there were no indications at the time to show, in so far as Belgium was concerned, that the "world crisis" would affect her as much as it did.

It may be said that Belgium did not begin to feel its effects until the year was fairly well advanced, and the decline of production and exports only began to be felt acutely from the beginning of June. Belgium has, however, probably been able to withstand the effects of the widespread depression than almost any other European country except France. The shortage of labour reported in 1929 was, however, transformed into unemployment in certain industries, but not to any alarming extent.

In conclusion the Commerical Secretary adds that, whilst it is impossible at the period of writing to prophesy what will happen to Belgium in the future, nevertheless, on all sides the opinion has been expressed that as she was the last to feel the effects of the universal depression, so will she also be the first to recover therefrom.

The second chapter deals with finance. The situation of the National Bank of Belgium remains steady, but the budget estimate for 1931 shows a deficit for the first time since 1926, the year of stabilisation. Chapter III furnishes a most comprehensive and valuable review of foreign trade and industry, dealing with each principal industry separately and containing much important information in regard to British trade prospects. This section is followed by chapters on agriculture and fisheries, transport and communications (containing an exhaustive summary of shipping conditions), legislation and administration, and social questions.

There is also an annex dealing with the economic situation in the Grand Duchy of Luxemburg, the Report being completed by the addition of nine statistical appendices relating to finance, foreign trade, agriculture, freight rates, etc.

The Manchester City Council is again offering a number of Scholarships tenable in the Faculty of Technology of the University of Manchester. Successful candidates are required to follow a full-time course leading to the degree of Bachelor of Technical Science in the College of Technology, and Matriculation or its equivalent is an essential qualification.

For students who have been engaged in industry, and who have attended part-time day or evening classes, the Scholarships are of the value of £100 per annum, while for students leaving Secondary or Central Schools the value is £60. Both classes of Scholarships are tenable for three years.

In a recent number of the *Chemisch Weekblad*, Prof. W. P. Jorissen has contributed a paper on the induced oxidation of lactic acid and its signficance in the carcinoma problem.

Forthcoming Events.

FRIDAY, JUNE 12.

ROYAL INSTITUTION, 21, Albemarle St., W.1., at 9 p.m. "Latest Excavations at Ur," by Dr. C. L. Wolley.

WEDNESDAY, JUNE 17.

FARADAY SOCIETY, Royal Institution, Albemarle Street, W. Spiers' Memorial Lecture. "Michael Faraday," by Dr. R. L. Mond.

SOCIETY OF GLASS TECHNOLOGY. Sheffield, at 2 p.m.

FRIDAY, JUNE 19.

PHYSICAL SOCIETY. Imperial College of Science, S.W.7., at 5 p.m.

MONDAY, JUNE 29—FRIDAY, JULY 3.

Internationl Congress of the History of Science and Technology, London.

MONDAY, JULY 13—FRIDAY, JULY, 17.

INSTITUTION OF MECHANICAL ENGINEERS. Cambridge Summer Meeting.

MONDAY, JULY 13, TO SUNDAY, JULY 19.

S.C.I. Jubilee Celebrations and Fiftieth Annual Meeting. Headquarters, Great Central Hotel, Marylebone, London, N.W.1. MONDAY, JULY 13. 11.30 a.m. Opening of Chemical Plant and Research Instruments Exhibition by the President. 1 p.m. Luncheon, Hotel Victoria, W.C.1. Tickets 6s. 6d. 3 p.m. Reception by Lord Mayor and Sheriffs at Guildhall, E.C. 8.15 p.m. Reception by the President and Lady McGowan, Great Central Hotel, N.W. 9 p.m. Musical entertainment. TUESDAY, JULY 14. 10 a.m. Council meeting. 10.30 a.m. Annual General Meeting, Royal Academy of Music, Marylebone, N.W. 12.45 p.m. Luncheon, Great Central Hotel. 2.10 p.m. Start for Garden Party, Lensbury Club, Teddington. 5.30 p.m. Reception of Original Members, Girdlers' Hall, E.C. 7 p.m. Reception and meeting by the Master of the Salters' Company, Salters' Hall, E.C. "Recent Developments of the Society of Chemical Industry in Basle," by Dr. G. Engi. Also address by Dr. Henrich Schicht. 9 p.m. Lecture by Prof. R. V. Wheeler on "Dust Explosions," Home Office Industrial Museum, Westminster, S.W. 10 p.m. Visit to printing works of *Daily Mail*. WEDNESDAY, JULY 15. 10.30 a.m. Presentation of the Society's Medal to Dr. Herbert Levinstein, followed by an Address by the Medallist at Royal Academy of Music, Marylebone Road, N.W.1. 10.30 a.m. Tour by coach through London. 2 p.m. Works visits:—Wallpaper Manufacturing Co., Ltd. (A. Sanderson and Sons, Perivale); General Electric Research Laboratories at Wembley; Achille Serre, Ltd., Walthamstow; British Drug Houses, Ltd., Graham Street, E.C.; South Metropolitan Gas Co., East Greenwich; Mortlake Brewery of Watney, Combe, Reid and Co., Ltd. 7.30 p.m. Annual Dinner, Great Central Hotel. Limited to 600 Members of the Society. No lady guests. 6.30 p.m. Dinner for ladies at Madame Tussaud's, followed by visit to cinema. THURSDAY, JULY 16. 9.30 a.m. All-day visit to Agricultural Research Station, Rothamsted. 10.30 a.m. Addresses will be given in Leathersellers' Hall, E.C. 10.30 a.m. Meeting for reading and discussing papers presented by overseas Members, Regent Room, Great Central Hotel. 10.30 a.m. Meeting for discussing papers published in the Journal of July 3, Marylebone Room, Great Central Hotel. 10.45 a.m. Tour by coach through London. 12.30 p.m. Luncheon, Trocadero Restaurant, W., followed by visit to J. Lyons and Co., Ltd., Cadby Hall, W., and Greenford factory. 2 p.m. Works visit:—National Physical Laboratory and Chemical Research Laboratory, Teddington; The Distillers Co., Ltd.; Burroughs Wellcome and Co., Dartford; Pyrene Co., Brentford and Firestone Tyre and Rubber Co., Brentford; Fuel Research station, Greenwich. 8.30 p.m. Reception by the President and Lady McGowan, Savoy Hotel, W.C. FRIDAY, JULY 17. All-day excursions:—9.15 a.m. Huntley and Palmer's Biscuit Factory, Reading; 9 a.m. Research Station of Anglo-Persian Oil Co., Sunbury-on-Thames; 9 a.m. Windsor Castle, Eton College, and then by river to Bourne End. 8.30 p.m. Reception and Dance, Imperial Chemical House, Millbank, S.W. SATURDAY, JULY 18. 9 a.m. All-day excursion to Oxford. SUNDAY, JULY 19. 10.30 a.m. Service, at St. Paul's Cathredral. 2.30 p.m. Visit Hampton Court. 3 p.m. Visit to the Zoo.

PRAGUE SUMMER SCHOOL.

July 20—August 8, at the Prague Summer School, during the long vacation there will be delivered lectures in English in a number of subjects including Literature, Art and Science in Czechoslovakia, the History and Geography of Central Europe, and there will also be language courses in German, Czechoslovak and Russian.

Particulars of the fees for one, two or three weeks, reduced railway fares and other facilities and excursions in connection with the course may be obtained from Dr. B. Trnka, 55, Smetana Square, Prague, Czechoslovakia.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

14,186.—Imperial Chemical Industries, Ltd., and Thomson, R. F. and Anderson, I. B. and Carter, P. G. —Production of benzanthrone derivatives. May 19.

15,306.—Blumenfeld, J.—Chemical manufacture. May 23.

15,046.—Casson, S. B., and Chemical and Metallurgical Corporation, Ltd., and Crabtree, J. W.—Manufacture of hydrochloric acid. May 21.

14,635.—I. G. Fardenindustrie Akt.-Ges. —Production of products of anthrapyrimidine series. May 18.

Specifications Published.

348,661.—Beckett, E. G., Bangham, P. F., Thomas, J., and Scottish Dyes Ltd.—Production and use of anthraquinone derivatives.

348,669.—Selden Co.—Contact sulphuric acid process.

348,944.—I. G. Farbenindustrie Akt-Ges. —Concentration of aqueous formic acid.

Abstract Published.

343,744.—Stibinic acids. I. G. Farbenindustrie Akt-Ges., Frankfort-on-Main, Germany.

Benzimidazolone-stibinic acids are prepared by treating an o-diaminobenzene-stibinic acid with sufficient of a chloroformic ester to react with one amino group only and then heating the resulting urethane in the presence of an acid. An example is given of the preparation of 2-oxo-benzimidazole-2 : 3-dihydride-5-stibinic acid from 3 : 4-diaminobenzene-1-stibinic acid and chlorocarbonic acid ethyl ester.

o-Diaminobenzene-stibinic acids are obtained by acylating an o-diamino-nitrobenzene, catalytically reducing the nitro group to the amino group, replacing the latter by the stibinic acid residue, and saponifying the products. Thus, 3 : 4-diamino-1-nitrobenzene is acetylated, the resulting 3 : 4-diacetyldiamino-1-nitrobenzene then catalytically reduced in alcohol using hydrogen under pressure and a nickel catalyst to 3 : 4 - diacetyldiamino - 1 - aminobenzene, which is then diazotized and transformed in known manner into 3 : 4-diacetyldiaminobenzene-1-stibinic acid, from which saponification with caustic soda yields 3 : 4-diaminobenzene-1-stibinic acid.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

"REVOL."

514,017.—Chemical substances, being solvents for treating cloth in the course of manufacture. — Glover Brothers (Leeds) Ltd., Wortley Low Mills, Whitehall Road, Leeds. May 27th. (By Consent.)

ALKYDALE.

520,182.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany. May 27. (Associated.)

FLAVODINE.

521,676.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Boots Pure Drug Co., Ltd., 37, Station Street, Nottingham. May 27. Associated.)

THE CHEMICAL NEWS

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A list of various Important Scientific Books for Sale at usually ***less than half published prices*** *will be sent on application to the Manager, Chemical News, Merton House, Salisbury Square, London, E.C.4.*

RESISTIVITIES OF THE METALS AT 18° C. AND THE PROBLEM OF THEIR RELATIVE ABUNDANCE IN THE UNIVERSE; AND AS AN ASIDE THE DISTRIBUTION OF RADIANT ENERGY FROM THE SUN.

By F. H. LORING.

PART I.

This study relates mainly to the pure metals but includes those on the borderland between metals proper and non-metals individually having specific electric resistances per centimetre cube—resistivities—greater than that of bismuth which is generally given as 119×10^{-6} ohm at 18° C. Bismuth is taken practically as the limiting metallic member in this case. The term *pure metal* is not intended to imply absolute purity.

It is to be noted that the removal of the last traces of impurity lowers the specific resistance, but only in a few cases can the metals be said to be free from traces of impurity. This seems to be so, since the resistivity values have generally become less as new determinations have been made with purer elements.

The nature of the impurity, apart from its quantity, makes some difference in the resistivity, for usually the contaminating element exercises greater resistance-changing qualities the further it is from the metal under investigation. That is, as they are removed from each other in the periodic classification; but this statement is only a general one made by Lindemann [1].

Lindemann [1] also points out that the elements of the lowest resistivity fall in Group I, copper, silver and gold having the lowest. Taking the alkali metals in the order of their abundance the values at 18° C. run: Na 4.5×10^{-6}, K 6.8×10^{-6}, Li 9.2×10^{-6}, Rb 12.9×10^{-6}, Cs 20.5×10^{-6}. This series together with the limiting value 119×10^{-6} for bismuth at 18° C., calls to mind the so-called probability numbers or constants as evolved from the atomic numbers of the inert gases by the equation:— $\{2 \times (1^2+2^2+2^2+3^2+3^2+4^2+4^2)+n^2\}/n$ = probability numbers 3, 7, 9, 13, 21, 45, 119, when $n=1, 2, 3, 4, 3, 2, 1$, the equation being worked in seven steps by stopping off terms; therefore, (Prob. No.) $\times n - n^2 =$ atomic number, these corresponding numbers being exactly identified thus:— 2 = He; 10 = Ne; 18 = Ar; 36 = Kr; 54 = Xe; 86 = Rn, Rn, Tn, An, taken collectively (isotopes);

118 = Limiting atomic number for the inert gases if the periodic table be extended hypothetically (Bohr) [2]. From a study of the periodic table of the elements, it will be seen that the inert gases form a sort of backbone or central line in this classification when considered as developed round a closed surface. Enlarging the idea of isotopes, the inert gases are practically isotopic being more nearly alike than other distinctive elements in the classification. They might, therefore, be referred to as the *sea-level* members. The alkali metals coming next are perhaps more characteristically alike than elements of other typical groups; hence it might be expected that these elements would follow a probability rule with regard to some physical property, as appears to be the case in respect of the resistivities when taken in the abundance sequence. The present writer's wedge periodic table (see book cited in reference 8) brings out this sea-level idea in connection with the alkali metals.

119 being a limiting value in both cases and coinciding exactly in magnitude is probably a chance coincidence, but if so the lower resistivity values which follow may of necessity belong to the same chance, for the values are probably related to probability numbers, otherwise this could hardly be the case. It is, therefore, desirable to try to group the known resistivities so as to bring out this chance relationship. Putting this another way, if two end constants of two sorts of series coincide, then if both be based on probability the constants which follow in the trains should coincide. This does not mean that the coincidence of the end values is *one* chance 'event' and those that follow *other* chance events, making a large number of coincidences independent of one another. It simply means that one coincidence involves coinciding trains. It is so easy to misjudge matters here that a *simple illustration, though imperfect* as an analogy, will clinch the idea. If two sticks of firewood, picked up at random, happen to have exactly the same weight, it does not follow that, because each stick has in it 10^n atoms, there are 10^n coincidences of a chance character, for this is obviously impossible. There is only *one* coincidence: the others follow of necessity.

It is difficult to choose a large number of constants, measured at various times by different investigators, and to have the values closely comparative. One need not trouble about quantities in *absolute* measure, as in correlating values a formula can contain an adjusting constant to bring them to the proper level for relative comparison with those values derived by means of an equation or through some other consideration. For example, 119×10^{-6} may not be the exact value for bismuth. When this value is finally adjusted, so that no doubt may arise as to its precise magnitude, then a general constant can be introduced to bring the said value together with others into comparative line*. Moreover, it sometimes happens that agreements are too good, and suspicion is at once aroused. Therefore, *exact* agreements must be regarded as accidental.

In measuring the electrical resistance of such varying substances as metallic and semi-metallic elements it must be remembered that the values obtained are in themselves somewhat variable according as the element taken is worked-up, wire-drawn or not, annealed, and even ageing may make a difference in some cases. Cobalt and chromium when aged show marked changes in resistance.

Elements, as drawn from single crystals, show variations from those drawn from mixed crystals of the same element, and an example of a lower resistivity being obtained from a single crystal of copper has been reported.

Fig. 1, with an inset classification table and one for single crystals shows how it is possible to attempt a co-ordinating scheme of the resistivities of the elements falling within the range shown.

Referring to this figure, very little explanation is necessary. The probability numbers are indicated by the short lines crossing the logarithmically-spaced ordinates at right angles, being measured off thereon from the base line. In the *original drawing*

* It looks very much as if any attempt to bring the values into *exact* agreement with any formula would fail, since the physical variables introduce many disturbing factors. In other words, only averages can agree. Therefore, any individual fine adjustments are not likely to improve matters much. This statement reminds one of the *principle of indeterminacy* (see *Chemical News*, 1930, *140*, 259-260; or see P. W. Bridgman, *Science*, 1931, 73, 539-547).

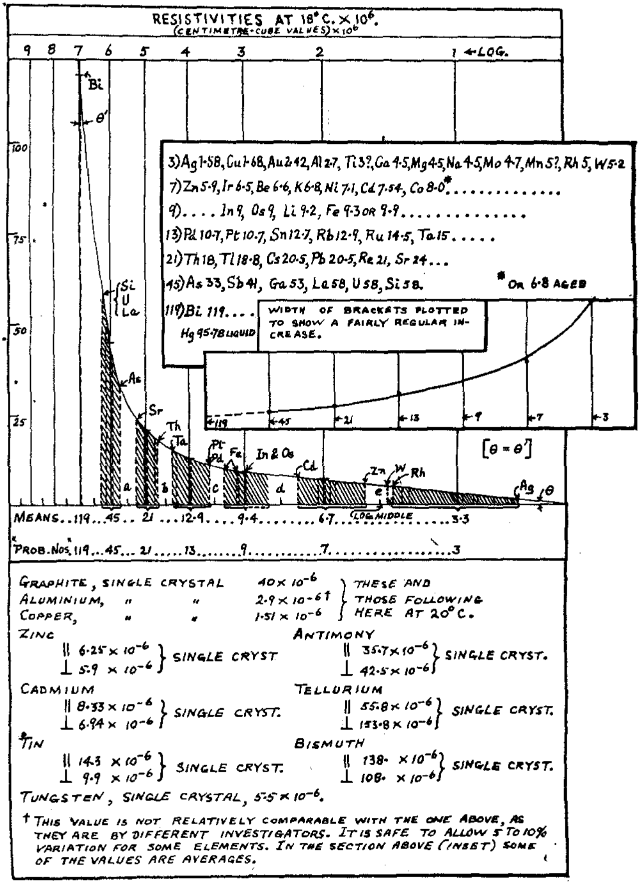

Fig. 1.

NOTE.—The harmonic means of the crystal values give the mixed values within the experimental errors involved in both cases.

the logarithmic scale (1 to 10) extends 250 mm. while bismuth stands 119 × 2 mm. from the base line and coincides with the resistivity value taken as 119 × 2. The other values are plotted to the same scale obviously, the scale-unit being 2mm. as originally drawn.

The curve shown, which is shaped to intersect the probability values, is not dead accurate in the 9-7-3 region, being there drawn as a straight line. On this account the mean value 3.3 is not to be regarded as accurately proportional to the width of the bracket shown; but these variations are so slight that the general scheme is hardly affected thereby. In each case the *means* are the sum of the *extremes* divided by two.

The spaces, *a*, *b*, *c*, *d*, *e*, may represent those in which no elements will fall, unless, of course, the distribution of the values is uniform from bismuth downwards — an interesting possibility.

The list of elements shown is not complete as in all there are 92 distinctive elements, counting by atomic number. 20 of these, including perhaps eka-iodine of atomic number 85 (undiscovered), are non-metallic in the sense that practically all those of resistivities appreciably above that of bismuth are practically non-metallic, at least from the point of view of this study. Boron, carbon, tellurium and selenium may be taken as non-metallic, or in some cases as semi-metallic, but they are included in the number 20. Of course the single-crystal state perhaps brings tellurium and graphite more into the metal range. If all the elements of higher atomic number than bismuth (83) be deducted, together with the above 20, then there would be 65 elements which would come into this study as based on the so-called probability numbers. Arsenic and silicon are included in the 65 as metals or semi-metals owing to their conductivity.

The curve shown may become very steep in the region of the ordinates 8 and 9, and of course the tenth one. Boron, carbon, selenium and tellurium and non-metals generally could doubtless be arranged to fall on the steep part of the curve, but the main feature of the scheme involves the limiting number 119—but possibly as a middle value in a set (say, the 7th resistivity set).

From Fig. 1 it will be seen that many metallic elements are necessarily missing as their resistivities are not yet known, and for this reason the scheme of co-ordination is made difficult. Table I shows the numbers of elements here studied, and those expected to fit into the scheme.

TABLE I.

A	B	C	D	E
3	12	15	3	16
7	7	13	6	14
9	4	11	7	12
13	6	9	3	10
21	6	7	1	8
45	6	5	-1	6
119	1	3	·2	4

A = the probability numbers associated with the rows of Fig. 1.

B = the present number of elements per row, the sum being 42.

C = an arbitrary series showing how the rows may be filled, the sum being 63.

D = the number per row missing, the sum being 21.

E = full metallic complement suggested when counting the metallic radioactive elements by atomic number, the sum being 70. The non-metals (22) would then be :— 1, 2; 5, 6, 7, 8, 9, 10; 14, 15, 16, 17, 18; 33, 34, 35, 36; 52, 53, 54; 85, 86. These values are of course atomic numbers and represent the elements so as to show progressive "runs" of 2, 3, 4, 5, 6, 2 elements.

Considering E, there is experimental evidence pointing to the respective isotopes of a general element having the same resistivity. An example will make this statement clearer. Radio-lead has the same specific resistance as ordinary non-radioactive lead, these two leads being isotopic, and as expressed in terms of atomic number they are the same general element, using the word *element* as signifying a specific class.

Mercury, being a liquid at ordinary temperatures, may not be eligible for the scheme as shown. If, however, it be inserted it would become a member of the bismuth set, having, say, 3 or 4 members when completed. Element 85 might be of this set, as also zirconium possibly taken as 167×10^{-6} at 18 or 20°C. Moreover, some of the rare-earth elements may fall into this set which may have values round—

$$\{(77+91)/2\} \times 10^{-6} \text{ at 18 to 20° C.},$$

taking a mean of the possible values of Ce and Pr.

In compiling the resistivity values of Fig. 1, use was made of several existing tables [3], but some values are taken direct from recent papers.

(*To be continued.*)

AN ENGLISH BIOGRAPHY OF LAVOISIER.

Antoine Laurent Lavoisier (1743-1794), acclaimed by some as the " Father of Modern Chemistry," has been the subject of many biographical essays but there has hitherto been no book in English devoted exclusively to his life and work. Chemists, and especially those interested in the history of science, will therefore be grateful to Mr. J. A. Cochrane for his very able volume describing the life of Lavoisier and his great influence upon the development of chemistry at one of the most critical periods of its history.

Black's experiments on "magnesia alba" and chalk, Cavendish's careful studies in the volumetric composition of gases, the sparking of mixtures of air and hydrogen, Scheele's numerous chemical discoveries and, above all, Priestley's work, supplied Lavoisier with just the material he needed to build up his theories. Lavoiser's own experiments were nearly all repetitions and modifications of work initiated by others. It was thus extravagant of Wurtz to write, in 1868, that " La chimie est une science francaise, elle fut constituée par Lavoiser." Grismaux, Lavoisier's French biographer, also exaggerates when he states, " toute la science moderne n' est que le développement de 'loeuvre de Lavoisier.

The work of Lavoisier's predecessors and contemporaries cannot be ignored, and if chemistry ever was a purely French science, it has long since taken on an international character.

As Mr. Cochrane points out, no student of the history of science contests Lavoisier's inclusion among the great chemists but it is futile to suggest that any particular man or country has done the most for the progress of chemistry. Neither is it profitable to compare such men as Priestley with Lavoisier. Both were geniuses and both contributed greatly to the advancement of science. Priestley's experimental skill enabled him to isolate oxygen and to carry out crucial tests with it. Lavoisier seized upon the facts supplied by Priestley's work and put forward new views on the nature of combustion.

An unfortunate trait in Lavoisier's character was his appropriation of the work of others which he put forward as his own. This is well illustrated in connection with Priestley's visit to Paris in 1774 where in conversation, he announced his discovery of " dephogisticated air " by heathimself in terms of the current phlogiston theory. Lavoisier, not being in any way influenced by the phlogiston dogma, realised the significance of Priestley's dising *mercurius calcinatus per se*, expressing covery, especially as a means for explaining the phenomena of combustion. He repeated Priestley's work and having obtained the same results he embodied them in a paper to the French Academy, to which he had been elected in 1768. He described the new " air " (oxygen) and although he made no attack on the phlogiston theory he actually began to accumulate the evidence which was finally to overthrow the older views. No mention was made of Priestley or of his experiments and even when this omission was pointed out, Lavoisier only grudgingly acknowledged that Priestley, may have preceded him in his discoveries.

The paper caused considerahle stir and was followed by others in which he attempted to explain the nature of the calcination of metals and the combnstion of nonmetals. He pointed out that all acids contained " vital air " which he imagined to be a compound of oxygen (the acidifying principle) *and* fire matter or caloric. Cavendish's discovery of the composition of water supplied Lavoisier* with another link in his chain of evidence which was to discredit the phlogiston theory, although he himself retained the equally fantastic " caloric," embodying it in his theory as one of the essential facts (!)

Brilliant as was Lavoisier's exposition, few chemists were attracted to his views before 1784.

Nevertheless, evidence gradually accumulated which indicated that combustion was a process of oxidation and did not involve the loss of an indefinite and elusive phlogiston. First the French scientists accepted the new views. Black, Bergman and Klaproth in other countries fell into line. Cavendish and Priestley, however, remained unconvinced to the end.

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* Lavoisier also failed to concede any credit to Cavendish and this evoked wellmerited protests from Blagden, the Secretary of the Royal Society.

Lavoisier. By J. A. COCHRANE, B.Sc. Pp. xiv + 264. London : Constable and Company. 1931. Price 7s. 6d.

In 1789, Lavoisier published his *Traité Elementaire de Chimie*, which soon established itself as an important text book, and was generally adopted for teaching purposes. It put forward a new nomeclature which had been worked out by Lavoisier *in conjunction* with de Morveau, Berthollet and Fourcroy. Most of their labours have stood the test of time. It simplified the understanding of chemical processes and placed the subject on a scientific and logical basis.

Lavoisier was a prolific writer but many of his memoirs, reports and letters contained little that was now of permanent value. He led a most active life, sitting on committees of the French Academy, the *Ferme Génerale*, the Gunpowder Committee and the Weights and Measures Committee. In all spheres he brought his influence to bear and effected many useful improvements of national importance. Thanks to a series of fortunate circumstances he never lacked money or means for his experimental work and his schemes for amelioration of the peasants with whom he was brought into contact at Blois and elsewhere.

The down-trodden state of the peasantry in 1789 led to French Revolution which was to cost Lavoisier his life in 1794. His association with the *Ferme Génerale*, a kind of private company to whom the levying of taxes was farmed out and the Gunpowder Committee prevented him from entirely avoiding contemporary political matters. Mr. Cochrane has traced considerably in detail Lavoisier's incursions into politics. He was evidently well-meaning, and was undoubtedly misunderstood by the revolutionaries who were suspicious of all they could not understand. His enemies seized on this. His good services in improving French gunpowder and in standardising Weights and Measures were ignored and he suffered the same fate as the other *fermiers*. His non-scientific activities interesting though they be, have been forgotten. His greatness rests in his real contributions to chemistry by explaining both his own work and particularly that of his contemporaries. His execution has been called the gravest blunder of the revolution. As Lagrange said on viewing his burial, it required but a moment to cut off his head but perhaps a century will not suffice to produce another.

J. G. F. DRUCE.

DIATOMACEOUS EARTHS PRODUCED IN JAPAN FOR FILTRATION OF SUGAR SOLUTIONS.

By T. TANNO and M. ODAGIRI.

The chemical compositions and some physical properties of the Japanese Diatomaceous Earths undermentioned were compared with those of the four kinds of the Supercells (included the dicalites) imported from the United States of America, and the mechanical structure of the representative cells of each earth were also examined under the microscope.

(*a*) Kitami, Hokkaido prefecture.
(*b*) Shichinohe, Aomori prefecture.
(*c*) Katta, Miyagi prefecture.
(*d*) Nagawoka, Niigata prefecture.
(*e*) Sado, Niigata prefecture.
(*f*) Nodo, Ishikawa prefecture.
(*g*) Mimasaka, Okayama prefecture.
(*h*) Hetsugi, Oita prefecture.
(*i*) Keisho-Hokudo, Chosen (Korea).

It was found that the properties of the Diatomaceous Earths produced in Sado, Niigata prefecture and Nodo, Ishikawa prefecture were similar to those of the American Supercells which are generally recognised as the most suitable filtration medium for sugar solutions.

According to the results obtained by the microscopical examination and the chemical analysis of each Earth, it may be concluded that the Diatomaceous Earths similar as the American Supercells are principally produced in the districts along the sea coast of the Japan Sea.

MARKETS FOR PHARMACEUTICAL CHEMICALS.

REPORT ON THE TRADE IN DENMARK.

A confidential report on the market for pharmaceutical chemicals in Denmark has been prepared by the Department of Overseas Trade from information furnished by the Commercial Secretary to H.M. Legation at Copenhagen and issued to firms whose names are entered on its Special Register.

United Kingdom firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 25, Old Queen Street, London, S.W.1. Reference number F.X. 1189 should be quoted.

GENERAL NOTES

THE BELGIAN CHEMICAL INDUSTRY

The Belgian Chemical trade began to fall off in the early part of 1930 and has continued to do so. Both the home and export markets have been very dull and future prospects do not look very bright, The output of acids has increased rapidly and at present exceeds consumption to a great extent, while sales of chemical manures have suffered owing to the agricultural crisis. Stocks have been down, however, by the expedient of reducing production.

Prices have fallen since the beginning of the year, the reduction being about 23 per cent. for acids and from 10 to 15 per cent. for chemical manures. The prices of other chemicals were less affected and for some commodities remained stationary.

Belgium uses proportionately more chemical, and particularly nitrogenous fertilisers than most other countries, and the consumption up till 1929 was increasing, as will be seen from the following table :—

	1913	1925	1928-29
Nitrate of soda	164,000	170,000	141,500
Sulphate of ammonia	50,000	84,450	150,000
Cyanamide	3,250	16,700	38,300
Nitrate of lime	—	2,600	10,000
Total of nitrogenous fertilisers	217,250	273,750	339,800

These figures represent a consumption of nitrogen amounting to 36,000 in 1931, 46,500 in 1925, and 59,700 tons in 1928-29.

Sales of nitrogenous fertilisers are regulated by the Comptoir Belge des Engrais Azotes, to which most of the important Belgian producers belong. Belgium also adhered to the international nitrogen cartel concluded in August, 1930, for a period of twelve months. Under the terms of this agreement Belgian production of nitrogen would be reduced by 30 per cent.

The national output of sulphate ammonia has steadily, increased since the war, as is shown by the following figures :—

1913 tons	1925 tons	1929 tons
48,000 ...	71,500 ...	191,000

Of the latter quantity 86,000 tons were ordinary sulphate of ammonia and 105,000 synthetic sulphate of ammonia.

The output of sulphuric acid likewise shows an advance, *viz.* :—

1913 tons	1925 tons	1929 tons
580,000 ...	740,000 ...	800,000

Imports amounted to 18,000 tons (value Frs. 6million), chiefly fromHolland (8,000), France (6,900), and Germany (2,700 tons), as against 15,000 tons (value Frs. 5 mil lion) for the first nine months in 1929.

The home trade in dyes and colours has been good, and although there is a demand for reduced prices, these are on the whole the same as those ruling at the end of 1929. The export trade, on the other hand was poor, and in many markets business has almost ceased, as buyers owing to the general lack of confidence, are unwilling to commit themselves for the usual quantities and are merely covering theid immediate requirements. Conditions are particularly unfavourable in some of the South American and in the Balkan markets.

THE FIFTH GENERAL MEETING OF THE DECHEMA.

VIENNA, MAY 28-30.

The Dechema, German Society for Chemical Apparatus, held its general meetin gin Vienna at the same time as did the Verein deutscher Chemiker, German Chemists' Society. The scientific proceedings were exceptionally well attended and the papers which were communicated on the important subject, "The Separation of Liquids and Solids," aroused wide and profound interest. Even the tropical heat did not prevent the occurrence of lively discussion after the papers. In all twelve papers were communicated dealing with filtration in the laboratory and on the technical scale, the latter being naturally in the majority. We are informed that this interesting series of lectures will shortly be published as volume form of the Dechma Monographs.

On Saturday, May 30, those taking part in the general meeting were able to visit the almost completed new Institute of Chemical Technology of Inorganic Compounds, a part of the Vienna Technical High School. This Institute provides an almost ideal solution of the problem of enabling the students to work with apparatus which corresponds to factory scale conditions.

The success of this year's General Meeting of the Dechema has once more indicated in a very gratifying way how the efforts of this relatively young scientific organisation are receiving the unstinted praise and recognition of all those concerned.

THIRD INTERNATIONAL CONFERENCE ON BITUMINOUS COAL.

England will be represented by an outstanding group of scientists and men of affairs at the Third International Conference on Bituminous Coal, which will be held at the Carnegie Institute of Technology in Pittsburgh, Pa., U.S.A., November 16 to 21, 1931.

Prof. William A. Bone, of the Imperial *College of Science and Technology, London*; Dr. Cecil Lander, director of the Fuel Research Board, London; Dr. R. Lessing, consulting chemist of London; and Dr. W. H. Cadman of the Anglo-Persian Oil Company, London, are among the group that have accepted the invitation of Dr. Thomas S. Baker, president of the Carnegie Institute of Technology and organizer of the conferences, to participate in the international meeting next fall.

Other English fuel technologists who will either attend the congress in person or contribute papers are : Dr. M. Barash, West's Gas Improvement Company, Manchester; Geoffrey M. Gill, cousulting engineer, London; J. Ivon Graham, deputy director, Mining Research Laboratory, The University, Edgbaston, Birmingham; Dr. E. S. Grumell, Imperial Chemical Industries, Ltd., Northwick; Prof. H. G. A. Hickling, Departmeut of Geology, University of Durham, Newcastle-upon-Tyne; Harold Nielsen, consulting engineer, London; P. C. Pope, secretary, The Institute of Fuel, London; N. E. Rambush, general manager, Power-Gas Corporation, Stockton-on-Tees; and Dr. F. S. Sinnatt ,assistaut director, Fuel Research Board, London.

France and Germany will also be represented by impressive delegations at the Pittsburgh meeting. Profs. Mailhe and Camille Matignon, of the Sorbonne, and M. Andre Kling, director of the Municipal Laboratory of Paris, will contribute papers or attend the meeting.

From Germany will come Dr. Friedrich Bergius, Prof. Dr. Franz Fischer, and Prof. Dr. Ernst Berl. Twelve other German scientists have already accepted Dr. Baker's invitation to participate in the coal meeting.

Austria, Belgium, Holland, Poland, Spain and Switzerland also will have representatives at the meeting.

In America, the best scientific minds have been secured to take part in the meetings. The tentative programme shows that the economic side of the coal industry will be emphasised. The competition between natural gas, water, coal and petroleum as sources of power will be one of the chief topics of discussion. Carbonization, gasification and liquefaction of coal ,and new methods of utilization will also be discussed by authorities in the several fields.

A prominent group of American men of affairs will assist Dr. Baker in the organisation and administrative of the conference. This advisory board is composed of the following : James A. Farrell, president of the United States Steel Corporation; Mr. John Hays Hammond, prominent mining engineer; Mr. Samuel Insull, public utilities magnate; Mr. Frank B. Jewett, president, Bell Telephone Laboratories, Inc.; Hon. A. W. Mellon, secretary of the United States Treasury aud capitalist; Mr. F. A. Merrick, president, Westinghouse Electric and Manufacturing Company; Mr. Auguste G. Pratt, presideut, Babcock and Wilcox Company; Mr. H. B. Rust, president, Koppers Company; Mr. Matthew S. Sloan, president of the New York Edison Company; Mr. Gerald Swope, president, General Electric Company; and Mr. W. C. Teagle, president, Standard Oil Company of New Jersey.

BULGARIAN TRADE AND CONDITIONS IN MARCH.

Very little change took place in Bulgaria's economic position duriug March. There was a slight movement in the retail trade which usually takes place prior to Easter. The new machinery set up by the government for the handling of cereals for export is now completed, and quantities of cereals are being concentrated at various points in the country, ready for export. Towards the middle of the month there was a slightly better tone on the foreign consuming markets and prices moved slightly in an upward direction. With the approach of spring it is expected that trade in general will improve, particularly in the metal, iron, and construction lines. Textiles and yarns, woollen and cotton, remain the same as in January and February.

Industry in general has shown but little *improvement since the beginning of the* year, due mainly to the lack of orders consequent upon the reduced buying capacity of the nation, and the general tightness of the money market. With the retrenchment in salaries of the State employees,

which takes effect from April, it is anticipated that there will be a further curtailment and depression in trade commerce. Usually in February and March wholesale buyers place their orders with the local factories, especially the textile trade, for the seasons goods. Reports, however, confirm that the value of orders and quantities placed this year are from 25 per cent. to 35 per cent. lower than in 1930. Imports from abroad are being rapidly curtailed and confined to absolnte necessities.

There was a further drop in wholesale prices and especially the price of bread. With the measures which the Government are taking to control the prices of commodities of first importance and speculation with foodstuffs, it is expected these steps will contribute towards balancing the reduction in State salaries, especially those effected in the lower grades.

The rates of interest on short and long terms credits was reduced by the National Bank to 9 per cent. The large private banks also varied their rates according to the various classes of accommodations, which ranged between 11 and 14 per cent.

Conditions on the money market remained unaltered to that reported in our last bulletin. There was an abundance of liquid money offered to trading firms of good repute without much response, on the part of sound borrowers. On the other hand, money and credits for agricultural needs was very scarce and peasant debitors had considerable difficulties in meeting their obligations.

The new budget, which was recently voted in parliament provides for certain new works, especially railways, and it is anticipated there will be a slight revival in trade in general, which usually takes place in the middle of the year. The winter crops which are above the normal, owing to the particularly mild winter not only provide sufficient foodstuffs for the needs of the population but there will be an appreciable quantity available for export which it is expected will find a favourable market in June or July.

THE THIRTY-SIXTH GENERAL MEETING OF THE GERMAN BUNSEN SOCIETY FOR APPLIED PHYSICAL CHEMISTRY.

VIENNA, MAY 25-28, 1931.

This year's General Meeting of the German Bunsen Society in Vienna was not only an event of scientific importance but also a vigorous demonstration in favour of co-operation between Germany and Austria, which, if freed from tariff barriers, could work together in the greatest harmony. In the opening session which was introduced by a speech of the President Miklas, this point of view was especially forcibly expressed as being particularly important with reference to the sphere of physical chemistry with its combinations of theory and practice.

This year the discussion centred round the problems of metallurgy, with particular reference to light metals. The first chairman of the Bunsen Society, Dr. Speketer of Frankfurt-Griesheim, emphasised the increasing importance of aluminium, magnesium, and their alloys. He showed in a few words how the aluminium production of the world had risen in the post war period, and pointed out that in all transport operations the desire to reduce ballast leads to the use of aluminium and its alloys with specific weights only about one-third that of iron. Similarly the other papers dealt with various metallurgical problems and that of Professor Tammann, of Göttingen, the well-known authority on metallurgical preblems who celebrated his 70th birthday during the meeting, was especially well received. The Professor of theoretical physics at the Technical High School in Berlin, R. Becker, showed in his concluding lecture that it is possible, by means of wave mechanics and quantum mechanics, to explain certain electric and magnetic properties of metals which have so far appeared contradictory, and he was able, thanks to his lucid exposition, to throw open this very difficult and abstract field of thought to a very wide public.

Although the programme included sixty individual lectures, provision was also made for the entertainment of the participants. A great banquet was held in the banqueting hall of the "Hofburg," at which visitors were able to meet and the reception by the Ministers of education, of trade and of transport introduced them to the apartments of the famous Schloss Schönbrunn. The splendid Whitsun weather favoured excursions of all sorts into the surrounding country, and finally a special performance at the opera concluded the meeting.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, June 11.

Papers read.

Electron Emission from Langmuir Probes and from the Cathode of the Glow Discharge through Gases. By M. L. E. OLIPHANT. Communicated by Lord Rutherford, F.R.S.

This paper gives the results of measurements made to determine the relative proportions of the current carried by positive ions and electrons at the surface of a negatively charged Langmuir probe in an ionized gas.

It is found that for potentials above 600 volts the rate of increase of current to the probe is greater than that predicted by the original theory of Langmuir and Mott-Smith, and this is ascribed to electron emission from the electrode which increases with the energy of impact of the positive ions.

The energy delivered to the probes as heat has been measured by a compensation method which eliminates all corrections. From this energy and the potential of the probe relative to the surrounding space the positive ion current i_p can be obtained. If i is the observed total current to the collector, then $i-i_p$ is the electron current i. Values found for the ratio $i_e|i_p$ are in He 35.5 per cent., in Ne, 80.0 per cent., and in Ar 21.2 per cent. Very uncertain values are given also for H_2 and Hg. It is found that the ratio of electron to positive ion current is independent of the energy of the positive ions up to that corresponding to a potential of 600 volts, and thereafter increases. Neon is exceptional in that it shows a gradual increase in $i_e|i_p$ with potential from the beginning.

The results are then discussed from the point of view of the angle of impact of the positive ions on the electrode surface, and it is pointed out that there must be an emission of electrons produced by agencies other than the impact of positive ions. The significance of the results in the interpretation of the cathode phenomena of the glow discharge is briefly dealt with.

The Dielectric Coefficients of Gases, I. By H. E. WATSON, G. GUNDU RAO and K. L. RAMASWAMY. Communicated by M. O. Forster, F.R.S.

The dielectric coefficients of the five inactive gases and hydrogen have been measured at 25° and at—190° or—78° and compared with that of carbon dioxide.

None of these gases except argon has an electric moment detectable by the method of measurement employed, 0.05×10^{-18} being an upper limit for krypton and xenon. For argon the figure appears to be 0.03×10^{-81}, but this is probably a spurious result. For the remaining gases it is not more than 0.015×10^{-18}.

Further investigations of possible sources of error have been made and an approximate method of determining condenser distortion with pressure is described.

The Theory of Metallic Corrosion, IV. By G. D. BENGOUGH, A. R. LEE and F. WORMELL. Communicated by Sir Harold Carpenter, F.R.S.

The effect of the corrosion of zinc of faster and slower rates of oxygen supply than those used for previous papers has been studied, and some comparisons made with the corrosion of mild steel. Complete curves are given showing the effect of concentration of potassium chloride and of potassium sulphate on the corrosion rates of zinc in tranquil conditions. The influence of depth of immersion between limits of 0.35 mm. and 100 mm. has been ascertained. An explanation has been found for the departure from linear corrosion rates after prolonged immersion in potassium chloride solution. A micro graphic study of the form and distribution of corroded areas has shown that very highly purified zincs yielded characteristic etch pits, but no preferential crystal boundary attack; less highly purified zinc rarely showed etch pits of definite shape but marked preferential attack on the crystal boundaries. The distribution of corrosion does not appear to be dictated mainly by differential aeration which is probably slight in tranquil conditions since oxygen has been shown to penetrate freely through mass of zinc hydroxide which were formerly thought to be "oxygen screens." It has also been shown that differential aeration does not usually cause greater corrosion on the less aerated of two zinc electrodes placed in solutions of potassium chloride. An hypothesis for the mechanism of the corrosion of zinc is proposed.

Papers read in title only :—

The Absorption of Hydrogen; Maintenance of a Monomolecular Layer and Liberation of Atoms with Emission of Energy.

By M. C. Johnson. Communicated by S. W. J. Smith, F.R.S.

Valve Methods of Recording Single α-Particles in the Presence of Powerful Ionising Radiations. By C. E. Wynn-Williams and F. A. B. Ward. Communicated by Lord Rutherford, F.R.S.

Intensity Measurements in the Absorption Band Spectrum of Lithium. By W. R. van Wijk and A. J. van Koeveringe. Communicated by O. W. Richardson, F.R.S.

Effect of Chemical Combination on the X-Ray Spectra of Copper. By E. A. Owen and T. E. Williams. Communicated by Sir William Bragg, F.R.S.

The Scattering of Light by Turbid Media. By J. W. Ryde. Communicated by R. H. Fowler, F.R.S.

Ethyl Alcohol, a Product of High Pressure Syntheses. By G. T. Morgan, F.R.S., and R. Taylor.

Absorption Spectra in Relation to the Colour of Solutions of Iodine Monochloride. By A. E. Gillam and R. A. Morton. Communicated by E. C. C. Baly, F.R.S.

Micelle Structure of Wool Fibre. By J. B. Speakman. Communicated by E. K. Rideal, F.R.S.

The Reflected Waves from Deep Focus Earthquakes. By F. J. Scrase. Communicated by G. C. Simpson, F.R.S.

Further Experiments upon Flame Propagation through Dry Carbonic Oxide-Oxygen Mixtures in an Electric Field. By W. A. Bone, F.R.S., R. P. Fraser and W. H. Wheeler.

The Dehydration of Copper Sulphate Pentahydrate. By J. Hume and J. Colvin. Communicated by R. Whytlaw-Gray, F.R.S.

On the Change of Resistance of Nickel in a Magnetic Field. By H. H. Potter. Communicated by A. P. Chattock, F.R.S.

The Kinetics of the Oxidation of Cyanogen. By H. J. Hadow and C. N. Hinshelwood, F.R.S.

Studies of Co-ordination, II. By T. M. Lowry, F.R.S., H. Burgess, I. J. Faulkner and R. C. Traill.

The Hyperfine Structure of Thallium II. By J. C. McLennan, F.R.S., and M. F. Crawford.

On the Stability of Superposed Streams of Fluides of Different Densities. By S. Goldstein. Communicated by G. I. Taylor, F.R.S.

Effect of Variation in Density on the Stability of Superposed Stearms of Fluid. By G. I. Taylor, F.R.S.

The Mechanism of Change, II and III. By T. M. Lowry, F.R.S., and R. C. Traill.

The Conductivities of Tetraethylammonium and Ammonium Salts in Methyl Alcohol. By A. Unmack, E. Bullock, D. M. Murray-Rust and Sir Harold Hartley, F.R.S.

On the Moment Distribution of Moments in the Case of Samples drawn from a Limited Universe. By L. Isserlis. Communicated by M. Greenwood, F.R.S.

The Collision of Electrons with Simple Atomic Systems and Electron Exchange. By H. S. W. Massey and C. R. O. Mohr. Communicated by Lord Rutherford, F.R.S.

The Emission of Electrons under the Influence of Chemical Action. By A. K. Denisoff and O. W. Richardson, F.R.S.

Further Estimates of the Impact Limits of X-Ray Generators. By A. Muller. Communicated by Sir William Bragg, F.R.S.

A Method of Measuring Magnetic Susceptibilities. By P. Kapitza, F.R.S., and W. L. Webster.

Analysis of the Long Range α-Particles from Radium C. By Lord Rutherford, F.R.S., F. A. B. Ward and W. B. Lewis.

Interfacial Tension and Hydrogen Ion Concentration. By R. A. Peters. Communicated by C. N. Hinshelwood, F.R.S.

The Influence of Hydrogen Ion Concentration upon the Adsorption of Weak Electrolytes by Pure Charcoal. II. By H. J. Phelps. Communicated by C. N. Hinshelwood, F.R.S.

Discontinuities at the Melting Point of Bismuth. By W. L. Webster. Communicated by P. Kapitza, F.R.S.

The Spectrum of the Flame of Carbon Disulphide. By A. Fowler, F.R.S., and W. M. Vaidya.

Explosion Waves and Shock Waves, I and II. By W. Payman and D. W. Woodhead. Communicated by J. F. Thorpe, F.R.S.

The Gyromagnetic Effect for Paramagnetic Substances, II. By W. Sucksmith. Communicated by A. P. Chattock, F.R.S.

The Adsorption of Hydrogen Cyanide and of Carbon Dioxide at Low Pressures by Activated Charcoals. By A. J. Allmand, F.R.S., and R. Chaplin.

The Wave Resistance of an Ellipsoid. By T. H. Havelock, F.R.S.

The Band Spectrum of Yttrium Oxide (YO) with a note on the ScO and LaO Systems. By L. W. Johnson and R. C. John-

SON. Communicated by O. W. Richardson, F.R.S.

The Spark Spectrum of Tellurium—Te IV. By K. R. RAO. Communicated by A. Fowler, F.R.S.

CHEMICAL SOCIETY.

June 4.

Adsorption of Nitrogen by Condensed Atomic Platinum. By S. H. BASTOW.

Experiments are described on the behaviour of platinum films deposited on glass at very low temperatures. Platinum vapour was condensed in a thin film on glass surfaces cooled by liqnid air. This nlm was found to absorb nitrogen strongly, though no very definite quantitative relation between the platinum and nitrogen could be established.

The platinum film sintered on warming, and in re-cooling was found to have lost much of its adsorptive capacity. Rough measurements were made of the rate of sintering as indicated by the percentage of nitrogen readsorbed. The adsorbed nitrogen was found to react with water vapour or hydrogen admitted while the film was at liquid air temperatures to form ammonia.. About 60 per cent. of the nitrogen reacted if the film had not been allowed to sinter. If, however, the film bad been partially sintered and some of the nitrogen desorbed, the percentage of the remaining adsorbed nitrogen which reacts falls.

The reaction between nitrogen and water vapour involves a large increase in free energy (92.6 kg. cal. per g. mol. of nitrogen concerned), and it is suggested that this energy is supplied by the platinum film in the process of sintering.

The Direct Formation of Quinones from 2 : 6-disubstituted Derivatives of 4-Nitrophenol. By E. C. S. JONES AND J. KENNER.

2 : 6-Diphenyl-4-nitrophenol was found to yield 2 : 6-diphenyl-*p*-quinone when heated in glacial acetic acid solution or alone, and the nature of this reaction has therefore been studied. It appears to be applicable to all derivatives of *p*-nitrophenol carrying *ortho-para*-directive substituents in the 2- and 6-positions, but not to 2 : 6-dicarbethoxy-4-nitrophenyl. The nitrogen is in all cases evolved as nitric axide, as it also is shown to be conversion of 2 : 6-dichloroquinitrol into 2 : 6-dichloroquinol. Although these reactions thus appear to be differentiated from the conversion of aliphatic *aci*-nitro-compounds into aldehydes or ketones and nitrous oxide, they, as well as the formation of anthranilic acid from *o*-nitrotoluene, of stilbene and dibenzyl derivatives from *p*-nitroluene, of anthraquinone oxime from nitroanthacene, and of 3 : 5-dinitroanisole from 1 : 3 : 5-trinitrobenzene, can all be co-ordinated. The divergence of the aliphatic reaction from that now investigated is attributed to the influence of heterogeneity of conjugation. As a consequence of this, dissociation into nitric oxide and an aromatic residue occurs, and this change is regarded as the oragnic analogue of the dissociation of nitrogen tri- and tetr-oxides. An explanation is thus provided for the apparently abnormal valency of nitrogen in its mono- and di- oxides.

The conversion of the nitrophenols in question into quinones and nitric oxide is quantitative, and occurs practically at the ordinary temperature, in acetic acid solution in presence of lead tetra-acetate.

The intteraction of 2 :6-dichloro-4-methylquinitrol with Methyl and Ethyl Alcohols.

The compound isolated by Zincke from the action o fmethyl alcohol on 2 : 6-dichloro-4-methylquinitrol is shown to be 2-methoxy-2-(2′ : 6′-dichloro-4′-tolyloxy)-4-methyl-6-chloro*cyco*hexan-3 : 5-dienone 2 : 6-Dichloro-4-nitrophenol, 3 : 5-dichloro-4-4hydroxybenzylmethyl ether, 2 : 6-dichloro-4-methyl-ψ-quinol, have also been isolated as products of the reaction.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated to the Society :—

Micro-identification of Amino-Acids with Polarisation Microscope. Part I. On Glutamic Acid Hydrochlorides. By YOSHITARO TAKAYAMA.

The Relation between Kolbe's Reaction and the Hydrogen Ion Concentration. III. The Comparison of the Electrolysis of Ammonium Acetate and Potassium Acetate. By RYOICHI MATSUDA.

Terpenes and Related Compounds. X. Chemistry of Isochavibetol (I) Action of Grignard's Reagent on Isochavibetolethers (I). By NENOKICHI HIRAO.

On the Rapid Preparation of Alkyl Iodide. By NENOKICHI HIRAO.

Sinomenine XXV. On Three Different Sinomenine Methines. By KAKUJI GOTO and HIDEO SHISHIDO.

Sinomenine XXVI.. On Hofmann Decomposition of Sinomenine with Dimethylsulphate and Alkali. By KAKUJI GOTO and KENJIRO TAKUBO.

NOTICES OF BOOKS.

Motor Benzole: its Production and use. By W. H. HOFFERT, M.A., B.Sc. (Oxon), F.I.C., and G. CLAXTON, M.Sc. (London), Research Chemists to the National Benzole Association, with a foreword by SIR D. MILNE-WATSON, LL.D., D.L., President of the National Benzole Association. Published by the National Benzole Association, Ltd. 1931. Pp. xx+689. Price 25s.

This will become a standard work in the industry and should be on the working bookshelf of everyone associated with the recovery of benzole through the high temperature carbonisation of coal; also, because of the manner in which the authors have treated modern coke-oven and gas-work practice, it will be found a useful addition to the standard literature available to engineers in charge of these plants. It was a happy thought of the authors to arrange the publication of this work coincident with the celebrations which are this year being held in honour of Faraday, the discoverer of benzole.

The reader may well place himself in the hands of so authoritative and reliable authors in view of their research work extending over a number of years on behalf of the N.B.A.

The physical and chemical properties of benzole are discussed at length, the utility of benzole in relation to the internal combustion engine discribed, chapters on the blending, storage and handling of benzole motor fuels are extremely explicit and general considerations affecting the economics of benzole recovery in regard to the calorific value, specific gravity and volume of gas are weighed fully. Tests and methods of analysis are described fully and useful Physical Tables and data giving, inter alia; atomic weights, vapour pressures, specific heats of gases and liquids, conversion factors and readings, and physical constants of constituents of benzole and other motor fuels, complete a work so valuable that one is left with the considered opinion, that the authors and the National Benzole Association have rendered a service not only to the Benzole and allied industries, but achieved the object, unwittingly perhaps, of assisting in the development of our national resources.

H.W.B.R.

A Short History of Atomism. By J. C. GREGORY. Published by A. and C. Black, Limited. 1931. Pp. 258. Price 10s. 6d.

The atom, being recognised for more than two thousand years as a fundamental in the science and philosophy of the Universe, the author, who is a Lecturer in Chemistry in the University of Leeds, here presents a genuine and reliable contribution to the history of atomism, in a manner (retaining as it does its scientific and historical accuracy), readily intelligible to the layman.

Gregory leads us from the early conceptions of Democritus in 420 B.C. to the more recent thought and discovery of Eddington and Jeans of the past few years. In the seventeenth century A.D. we find ourselves restoring the Atomic theory with Gassendi then leading to the researches of Sir Isaac Newton.

In the nineteenth ceutury we are leading to more advanced study through the discoveries of Dalton, Gay-Lussac, Avogadro, Prout, Faraday and Herapath until in 1895 Röntgen discovers his X-Ray, Lord Kelvin plans his electrically constituted atom and just before the close of the century Madame Curie isolates radium chloride. Early in the present century we are told in simple language, and Bohr's discovery, of Heisenbergs' new quantum theory, until Sir Arthur S. Eddington's *Nature of the Physical World* appears and about the same time Sir J. H. Jeans published his work, *Astronomy and Cosmogony.*

The book should prove interesting and the author has prepared a comprehensive chronological summary of the more important events in the history of the subject, which makes a fitting appendix to a noteworthy correlation of historical matter.

H.W.B.R.

Das Periodische System in Neuer Anordnung. By Dr. DARWIN O. LYON. Second Edition. Pp. 40 with 26 illustrations and diagrams and 4 sheets of tables. Leipzig and Vienna: Franz Deuticke. 1931. Price 8 marks (12 schillings).

Dr. Darwin Lyon of Vienna has made a special study of the correlation of the physical constants of the elements and their position in the Periodic Classification.

He has now arranged a series of tables and curves showing the periodicity of the elements illustrated by 14 sets of physical constants when arranged in order of their atomic numbers.

The author has evidently spent much time and thought in compiling the tables and constructing the diagrams and must be gratified to know that a second edition has been called for. In the text he traces significance and Bohr's Theory in connection with the Periodic System.

From his remarks it would appear that Dr. Lyon is not fully acquainted with all the studies on the Periodic Classification that have appeared in *The Chemical News* in recent years, notably F. H. Loring's numerous articles and his books *Atomic Theories* and *The Chemical Elements* and also the papers of Charles Janet. His tables, etc., compiled as they have been from the *International Critical Tables* and the *Annual Tables of Constants*, are of great interest to both chemist and physicist.

OFFICIAL PUBLICATIONS RECEIVED

United States Department of the Interior.

Geological Survey.

Geology of the Big Snowy Mountains Montana. By Frank Reeves. Professional Paper 165-D. Price 20 Cents.

Preliminary Report on the Ground Water Supply of Mimbres Valley, New Mexico. By Walter N. White. Water Supply Paper 637-8. Price 10 Cents.

Water-Power Resources of the McKenzie River and its Tributaries, Oregon. By Benjamin E. Jones and Harold T. Stearns. Water-Supply Paper 637-C. Price 15 Cents.

Surface Water Supply of the United States, 1927. Part V Hudson Bay and Upper Mississippi River Basin. By N. C. Grover, Chief Hydraulic Engineer. Water-Supply Paper 645. Price 20 Cents.

Nitrate Deposits in Southeastern California with Notes on deposits in Southeastern Arizona and Southwestern New Mexico. By L. F. Noble. Bulletin 820. Price 45 Cents.

Iron Ore on Canyon Creek Fort Aapche Indian Reservation Arizona. By Ernest F. Burchard. Bulletin 821-C. Price 15 Cents.

Scientific Papers of the Institute of Physical and Chemical Research, Komagome, Hongo, Tokyo, Japan.

X-Ray Diffraction by Incandescent Carbon. By M. Hirata.

Uber die Bandenspektren des Zinkhydrids. By Von M. Fukuda.

An Apparatus for the Detecting of Defective Insulators. By T. Uishi. Nos. 299 to 301. Price 50 sen.

Experimental Studies on Form and Structure of Sparks. Part VIII. By T. Terada and R. Yamamoto. No. 298. Price 90 sen.

Propagation of Wireless-Waves. By H. Nagaoka. No. 297. Price 30 sen.

Der Einfluss Metallischer Ueberzuge auf die Mechanischen Eigenschaften Von Stahl Beim Nitriern. Von T. Yosiki. No. 292. Price 25 sen.

Note on the Photoelectric Effect by Relativistic Wave Equation of Dirac. By T. Muto. No. 288. Price 25 sen.

Eine Einfache Graphische Methode fur die Berechnung des Partiellen Spezifischen Volumens von Eiweisskorpern. Von. T. Katsurai. Vol. 15 No. 13. Price 10 sen.

Science Reports of the Yokyo Bunrika Daigaku (Tokyo University of Literature and Science), Koishikawa, Tokyo, Japan.

On the Vapour Pressure of Liquid. Part II. On the Vapour Pressure, Henry's Constant and Osmotic Pressure of Concentrated Solutions. By K. Watanabe. Vol 1. No. 6. Price 30 sen.

Union of South Africa—Department of Agriculture.

Die-Back of Fruit Trees in the Western Cape Provinces. By Prof. O. S. H. Reinecke. Farmers' Bulletin No. 34. Price 3d.

A Review of the Maize Situation in the Union of South Africa. By W. J. Lamont. Economic Series No. 15. Bulletin No. 101. Price 3d.

Two Destructive Insects of Carnation Plants. By D. Gunn. Bulletin No. 94. Price 3d.

Commonwealth of Australia.

Journal of the Council for Scientific and Industrial Research, Vol. 4, No. 1. Price 1s. 6d.

Forthcoming Events.

MONDAY, JULY 13, TO SUNDAY, JULY 19.

S.C.I. Jubilee Celebrations and Fiftieth Annual Meeting. Headquarters, Great Central Hotel, Marylebone, London, N.W.1. MONDAY, JULY 13. 11.30 a.m. Opening of Chemical Plant and Research Instruments Exhibition by the President. 1 p.m. Luncheon, Hotel Victoria, W.C.1. Tickets 6s. 6d. 3 p.m. Reception by Lord Mayor and Sheriffs at Guildhall, E.C. 8.15 p.m. Reception by the President and Lady McGowan, Great Central Hotel, N.W. 9 p.m. Musical entertainment. TUESDAY, JULY 14. 10 a.m. Council meeting. 10.30 a.m. Annual General Meeting, Royal Academy of Music, Marylebone, N.W. 12.45 p.m. Luncheon, Great Central Hotel. 2.10 p.m. Start for Garden Party, Lensbury Club, Teddington. 5.30 p.m. Reception of Original Members, Girdlers' Hall, E.C. 7 p.m. Reception and meeting by the Master of the Salters' Company, Salters' Hall, E.C. "Recent Developments of the Society of Chemical Industry in Basle," by Dr. G. Engi. Also address by Dr. Henrich Schicht. 9 p.m. Lecture by Prof. R. V. Wheeler on "Dust Explosions," Home Office Industrial Museum, Westminster, S.W. 10 p.m. Visit to printing works of *Daily Mail*. WEDNESDAY, JULY 15. 10.30 a.m. Presentation of the Society's Medal to Dr. Herbert Levinstein, followed by an Address by the Medallist at Royal Academy of Music, Marylebone Road, N.W.1. 10.30 a.m. Tour by coach through London. 2 p.m. Works visits:—Wallpaper Manufacturing Co., Ltd. (A. Sanderson and Sons, Perivale); General Electric Research Laboratories at Wembley; Achille Serre, Ltd., Walthamstow; British Drug Houses, Ltd., Graham Street, E.C.; South Metropolitan Gas Co., East Greenwich; Mortlake Brewery of Watney, Combe, Reid and Co., Ltd. 7.30 p.m. Annual Dinner, Great Central Hotel. Limited to 600 Members of the Society. No lady guests. 6.30 p.m. Dinner for ladies at Madame Tussaud's, followed by visit to cinema. THURSDAY, JULY 16. 9.30 a.m. All-day visit to Agricultural Research Station, Rothamsted. 10.30 a.m. Addresses will be given in Leathersellers' Hall, E.C. 10.30 a.m. Meeting for reading and discussing papers presented by overseas Members, Regent Room, Great Central Hotel. 10.30 a.m. Meeting for discussing papers published in the Journal of July 3, Marylebone Room, Great Central Hotel. 10.45 a.m. Tour by coach through London. 12.30 p.m. Luncheon, Trocadero Restaurant, W., followed by visit to J. Lyons and Co., Ltd., Cadby Hall, W., and Greenford factory. 2 p.m. Works visit:—National Physical Laboratory and Chemical Research Laboratory, Teddington; The Distillers Co., Ltd.; Burroughs Wellcome and Co., Dartford; Pyrene Co., Brentford and Firestone Tyre and Rubber Co., Brentford; Fuel Research station, Greenwich. 8.30 p.m. Reception by the President and Lady McGowan, Savoy Hotel, W.C. FRIDAY, JULY 17. All-day excursions:—9.15 a.m. Huntley and Palmer's Biscuit Factory, Reading; 9 a.m. Research Station of Anglo-Persian Oil Co., Sunbury-on-Thames; 9 a.m. Windsor Castle, Eton College, and then by river to Bourne End. 8.30 p.m. Reception and Dance, Imperial Chemical House, Millbank, S.W. SATURDAY, JULY 18. 9 a.m. All-day excursion to Oxford. SUNDAY, JULY 19. 10.30 a.m. Service, at St. Paul's Cathredral. 2.30 p.m. Visit Hampton Court. 3 p.m. Visit to the Zoo.

SATURDAY, JUNE 20.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30 p.m.

PRAGUE SUMMER SCHOOL.

July 20—August 8, at the Prague Summer School, during the long vacation there will be delivered lectures in English in a number of subjects including Literature, Art and Science in Czechoslovakia, the History and Geography of Central Europe, and there will also be language courses in German, Czechoslovak and Russian.

Particulars of the fees for one, two or three weeks, reduced railway fares and other facilities and excursions in connection with the course may be obtained from Dr. B. Trnka, 55, Smetana Square, Prague, Czechoslovakia.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

15,428.—Anderson, I. B., and Imperial Chemical Industries, Ltd., and Thornley, S.—Production and use of anthracene derivatives. May 26.

15,510.—Du Pont de Nemours & Co., E. I.—Manufacture of 2-amino- and 2-substituted amino-arylenethiazoles. May 27.

15,386.—I. G. Farbeninudstrie Akt.-Ges. —Carrying out catalytic reactions. May 26.

15,773.—Nippon Chissohirye Kabushiki-Kaisha.—Synthetic manufacture of acetic acid. May 29.

Specifications Published.

349,067.—Soc. D'etudes Scientifiques et d'Entreprises Industrielles.—Treating saturated hydrocarbons and gaseous mixtures rich in saturated hydrocarbons.

349,037.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of ortho-nitro-arylarsinic acids.

349,080.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of conversion products of 1.2-anthraquinone-thioglycollic-carboxylic acid.

Abstract Published.

344,638.—Acetic acid; acetaldehyde. — Tanner, C. C., Norton Hall, The Green, Norton-on-Tees, and Imperial Chemical Industries, Ltd., Millbank, London.

Acetaldehyde alone or in admixture with acetic acid is obtained by passing a mixture of acetylene and steam over a bismuth compound, which may be supported upon a carrier. Preferably a phosphate or moylbdate of bismuth is employed, and the steam is used in large excess such as 2 to 10 times the volume of the acetylene. In an example, equivalent quantities of ammonium, molybdate and bismuth nitrate solutions are mixed, and ammonia is added to precipitate bismuth ammonium molybdate, which is dried, formed into pellets, and heated to 350° C. to expel the ammonia. A mixture of acetylene with seven times its volume of steam is passed over this catalyst at 300°C. Specification 332,635, [*Class* 2 (iii), Dyes &c.] is referred to.

The Latest Trade Marks

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

UTINAL.

522,400.—Chemical substances in Class 1, for use in the treatment of textile fabrics and leather in the course of their manufacture.—H. Th. Bohme Aktiengesellschaft, 29, Moritz - strasse, Chemnitz, Germany. June 4.

PRIMUZOL.

520,929.—Chemical solutions, in class 1, for use in preparing surfaces prior to painting or varnishing. — Pinchin, Johnson & C., Ltd., *trading* as Docker Brothers, General Buildings, Aldwych, London, W.C.2., and Rotton Park Street, Birmingham. June 4.

LAVIPAN.

522,437.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Carr & Day & Martin, Ltd., Blacking Factory, Brunswick Park Road, New Southgate, London, N.11. June 4.

CYCLONOL.

520,478.—Emulsifying agents, solvents and plasticisers, all being chemical substances for use in manufactures.—Deutsche Hydrierwerke Aktiengesellschaft, Kantstrasse 163, Berlin-Charlottenburg, Germany. June 4. (By Consent.)

THE CHEMICAL NEWS

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IMPORTANT NOTICE.

Next week's number, the first of Volume 143 will contain a speculation in article form of the Future of Science in the Next Century, by Sir Oliver Lodge, whose name needs no introduction to readers of the "Chemical News."—

Editor.

EDITORIAL.

ANGLO-CZECHOSLOVAKIAN TRADE. GROWING DEMAND FOR BRITISH GOODS.

Reduced foreign trade, increased unemployment, falling traffic returns and rising bankruptcy figures are all symptoms which indicate that Czechoslovakia is suffering from the general depression. Nevertheless writes the Commercial Secretary to H.M. Legation at Prague, the effects of the depression are probably less severe in this than in most other industrial countries, if only for the reason that the general stanward of living is not so high, society is composed of fewer graduations, and consequently variations in national wealth are less acutely felt individually.

The prevailing economic crisis is due to many causes. This country has, in common with world movements, suffered from unstable and falling prices. Manufacturers are buying raw and semi-manufactured materials only to fill immediate requirements. The reluctant consent of the heavy metal industry to reduce the home prices of certain iron and steel products for the building trades—at the urgent request of the Ministry of Commerce—was also hardly calculated to stimulate export trade. Nevertheless, ironmasters have held their own in those special lines which are peculiar to Czechoslovakia. The vital sugar question is also—though with difficulty—gradually settling itself. New markets are being found, and sugar manufacturers, refiners and beet growers are assiduously adjusting their inter-dependent finances. Hop growers have been particularly hard hit owing to bad trade and low prices, and prosperity will be impossible without Government assistance.

In short, it may be said that almost all the great industries, such as glass, porcelain, imitation jewellery, leather goods, furniture, textiles, etc., are suffering from causes too well known to require elaboration. The lack of the Russian market is also severely felt. Exports to that country in 1930 amounted to nearly £2,000,000, and imports into Czechoslovakia from Russia to about £1,800,000; but the absence of proper credit machinery is a handicap. In March, 1931, a contract was entered into between the Soviet Trade Commission and the Vitkovice Iron Works, whereby the latter is to deliver 40,000 tons

of iron and steel bars and sheets to Russia, with an option for the supply of a further 80,000 tons. The total contract represents a value of Kc. 120 million. The Vitkovice Works have agreed to purchase 350,000 tons of iron ore from Russia.

GOVERNMENT STIMULUS TO INDUSTRY.

In order to stimulate industrial activity during the present slack period the Government has decided immediately to invite tenders for Government supplies covering the whole of the year 1931 with the limits laid down in the Budget, delivery to be spread over several months. Since the beginning of 1931 Government departments have placed orders worth Kc. 1,264 million. These measures, and the prospect of replenishing the depleted stocks of merchants and dealers, have engendered a more hopeful outlook, and it is expected that moderate improvement in the general situation will make itself felt within the next few months.

HINTS TO BRITISH TRADERS.

The volume of British exports to Czechoslovakia in 1930 amounted to about £3,500,000 (Kc. 579,359,000), as compared with nearly £5,000,000 in 1929 (Kc. 817,257,000). The trade outlets therefore are not to be despised, especially as, with a gradual industrial revival and an increasing desire for articles of medium and superior quality, British goods are certain to come more and more into favour. There is ample and convincing proof of this in the flattering way that the word "Anglické," indicating English origin, is so widely employed by shopkeepers to convey the ideas of quality, attractiveness and durability to their customers, and the almost entire absence of the use of other foreign geographical names to the same end.

Ignorance of the Market.—The fact is often overlooked that Great Britain still enjoys a unique reputation on the Continent of Europe for commericial probity and for the excellence of her manufactures; and it is much to be regretted that advantage of this valuable asset is taken so sparingly by British exporters. So far as Czechoslovakia is concerned, the unvarnished truth is that a large number of British manufacturers and exporters are still only vaguely aware that Czechoslovakia is a new Republic of nearly 15 million inhabitants, possessing her own political constitution, quite separate and independent from Austria and Hungary, having her own Customs tariff and import and export regulations; and—let it not be overlooked—owning, in Bohemia and Moravia in particular, some industries as progressive and efficient as any in the world. Ignorance of these facts undoubtedly prevents British traders from realising the potentialities of the Czechoslovak market. It has the effect of engendering half-heartedness an exasperating habit of instructing commercial travellers to scan Prague (750,000 inhabitants) perfunctorily and to appoint agents almost between the arrival of one train from, say, Berlin and the departure of the next to Vienna—a custom which is deplorably frequent and which only too often brings serious consequences in its train. The appointment of agents is largely a question of personality and psychology, and of making tireless and not too hurried investigations. The problem of expense could be solved in some cases by a competent traveller representing several firms dealing in allied but not necessarily competitive lines.

Advertising and Exhibiting Goods. — British manufacturers of popular commodities are also advised to advertise within all reasonable limits. It is disheartening to witness extensive sales of well-advertised foreign articles which are in no wise superior to British goods, and which often enough enjoy little or no advantage in the matter of price. British firms have also failed to realise the practical value of the Prague International Samples Fair (about 3,000 exhibitors), which is held for eight days twice yearly, in March and September. As the Fair is usually visited on each occasion by 300,000 to 400,000 members of the public, the advantage of displaying articles, especially those retailed in shops, requires no emphasis. The cost of space varies between Kc. 80 and Kc. 100 (say, 10s. and 12s. 6d.) per square metre inside covered buildings, and between Kc. 25 and Kc. 100 (say 3s. to 12s. 6d.) per square metre in the open air. The expense could, if desired, be shared by one or more firms arranging to rent a room together.

Goods in which Trade might be Increased.—Careful enquiries carried out over a considerable area and among different interests have elicited the opinion that, with zeal and initiative, British trade in this country might be developed or increased more particularly in the following lines, providing, of course, prices are competitive :— chemical preparations, insecticides for domestic purposes, fine oils, phar-

maceutical preparations, patent medicines, veterinary preparations, chemical technical products, motor vehicles, motor cycles and accessories, electric conductors, apparatus and other electro-technical materials, photographic materials and apparatus, rubber and rubber goods, insulation materials.

Appointment of Agents.—Owing to the dual Czech and German language difficulty it is more than usually advisable for British firms to appoint a reliable and experienced local individual (or firm), who himself speaks Czech and German, or at all events whose commercial travellers speak Czech. Generally speaking, it is also most desirable to appoint a principal agent (usually on commission) in Prague, rather than a sub-agent controlled from, say, Berlin, Vienna or Budapest. There is a most virile movement here to "Czechise" economic life, and the same policy which has obliged practically all the large Bohemian financial institutions and industries to transfer their former head offices from Vienna to Prague applies with equal force to the agency question, unless there are very special reasons for acting otherwise. On the other hand, in such particular branches as materials (yarns, machinery, etc.) required for the textile trades, it would probably be more advantageous to appoint an agent in Liberec (Reichenberg) and perhaps another in Brno (Brünn), the two great textile centres. Virtually all the great metallurgical and engineering industries, however, have their head offices in Prague. There is no British Chamber of Commerce in Czechoslovakia. British firms and their travelling representatives are cordially invited to visit personally or communicate fully their requirements (enclosing if possible catalogues and price lists) to either the Commercial Secretariat of the British Legation, Thunovska 12, Prague III, or the British Vice-Consulate, Prikopy 6, Prague.

It is with the deepest regret we record the death in the service of his country, of Mr. E. W. Blair, B.Sc., F.I.C., Senior Scientific Officer, Royal Naval Cordite Factory, Holton Heath, who perished in the explosion which took place on Tuesday the 23rd inst., at the factory, with such heavy toll of human life.

RESISTIVITIES OF THE METALS AT 18° C. AND THE PROBLEM OF THEIR RELATIVE ABUNDANCE IN THE UNIVERSE; AND AS AN ASIDE THE DISTRIBUTION OF RADIANT ENERGY FROM THE SUN.

By F. H. Loring.

(*Continued from page 388.*)

Part II.

From the foregoing it will be seen that the most abundant elements tend to follow the probability numbers in distribution about as well as could be expected. This is indicated by Table II. In this case reference to following tables should assist in judging whether the abundance sequence is near to the truth or not; but of course the whole problem of abundance is difficult. Still, classification attempts may be made by way of suggesting ideas in this connection.

Table II.

Prob. No.	Element & Resistivity	Remarks.
3	$Ti = 3.0 \times 10^{-6}$	Abundant in stars*
7	$Ni = 7.1 \times 10^{-6}$	In the earth's core.
9	$Fe = 9.3 \times 10^{-6}$	In the earth's core.
13	————	Perhaps barium here
21	$Sr = 24 \times 10^{-6}$	Perhaps abundant in stars
45	$Si = 58 \times 10^{-6}$	Abundant in earth's surface.
119	$Bi = 119 \times 10^{-6}$	Abundant for this step.

It will be seen from tables to follow that nickel is equal to aluminium in meteorites, so that in the core of the earth nickel and titanium may approximate that of iron, as suggested by this table; but the considerable number of elements in the row where titanium is tentatively placed, has to be taken into consideration, as the favours, so to speak, may be divided or apportioned in some unknown way. In a Brazil meteorite nickel was as much as 34 per cent., iron being 64 per cent [4].

Russell, Dugan and Stewart [5] say:—"In a very few stars the lines of some one element (strontium, silicon, or occasionally barium) are so much stronger than normal as to suggest that the element is unusually abundant; but some other explanation may be the true one, and these cases are so rare as to emphasise the general similarity of

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* Failing titanium, aluminium might take this place.

composition," the idea being that all stars are of uniform composition (Miss Payne).

Table III, as here called for convenience in reference, is drawn up partly to show the abundance of titanium, but its resistivity value needs confirmation.

Much work has been done on the classification of the stars, and Table III is intended to show this classification and bring to notice some of the typical elements spectroscopically revealed.

TABLE III.

Class B.—The dark absorption lines of *hydrogen and helium are strong.* In several stars He^{++} (ionised helium having lost 2 electrons) appears. Lines of ionised silicon, oxygen and nitrogen are prominent. This class of star is sub-classified (as are others) by numerals following the designation letter. B5 stars show the K line of ionised calcium; B9 stars hardly show the helium *spectrum, e.g.,* Rigel and Regulus — bright stars in the Pleiades and several in the constellation of Orion.

Class A.—Hydrogen is prominent. Several metals, particularly ionised calcium and magnesium, are present; but their lines are weak in comparison with those of hydrogen. Sirius, Vega and Castor are of this class.

Class F.—Here the hydrogen lines are less prominent and the lines of metals begin to assert themselves, particularly the ionised lines of calcium. Passing to the sub-class, F8 and F9, they bear a strong resemblance to the sun in respect of their spectra. Typical F stars are Procyon and Canopus, these being white.

Class G.—The sun is of this class, and the spectra of many metals appear, notably the neutral or un-ionised lines of iron, but the ionised lines of hydrogen and ionised calcium are still prominent. Typical stars are the sun and Capella of the sub-type G0 (the sub-classes, as stated above, are designated by the *numerals 0, 1, 2, 3, etc.*), these *stars* being yellow.

Class K.—These stars are bright like Arcturus and Aldebaren, and the lines of *ionised* metals become weaker while the lines of un-ionised metals gain in strength. Near the end of this class bands of titanium oxide appear, and stars of this sort are orange in colour.

Class M.—The characteristic feature of stars of this class is the great strength of the titanium oxide bands, and the lines of neutral metals are also prominent. These stars are red. Antares and Betelgeuse are of this class.

In preparing this so-called table the present writer has drawn freely from Smart's popular book on astronomy [6].

It will be seen that titanium, like iron, may be regarded as a particularly abundant element in the universe. This is shown locally by the following sequences of elements placed in the order of decreasing abundance on the earth, on the sun, and in meteorites; here drawing from the recent studies of H. N. Russell [7]. In the following tables of quantitative sequence, arrows point in the direction of decreasing abundance. The long arrows (in two instances) indicate rather greater drops in abundance than are usual in the steps of the sequence. The bracketed symbols indicate about equal abundance. For example in Table IV, Ca = 8.8, Na = 8.7, K = 8.7, Mg = 8.6, etc.

TABLE IV—EARTH.

Si → Al → Fe → Ca →
(Na, K) → Mg → Ti →
Mn → Cr → V → Ni →
Cu → Zn → Co ⟶ Sc.

TABLE V.—SUN.

Mg → Fe → Si → Na →
K → Ca → (Al, Ni) →
Mn → (Cr, Co) → Ti →
Cu → (Zn, V) ⟶ Sc.

TABLE VII.—EARTH.

O → H → Cl → (C, P) →
S → (N, F).

TABLE VII—SUN.

H → O → N? → C → S.

According to Russell the sun's atmosphere may be specified about thus :— H = 46% ; He = 6% ; O = 24% ; Metals = 24%. The He value is queried. The 100% summation (representing *n* grams) is not, of course, final, so that the percentage values may be taken as approximate relative figures, according to present knowledge.

TABLE VIII.—METEORITES.

Fe → Si → Mg → (Al,
Ni) → Ca → Na → Cr →
Mn → K → Co → Ti →
Cu

Table IX—Meteorites.

O → S → C → P → (Cl, H).

The two following tables comprise the less abundant elements as compared with those above for the earth and sun.

Table X—Earth.

Ba → Zr → Sr → (Ce, Yt) → Li → Pb → (B, Be) → (Rb, As, Mo, Sn) → (Sb, Cd) → (W, Nb, Ta, Ag) → Pt → Tl → (In, Ga) → Ge.

Table XI—Sun.

B? → Ba → Sr → (Ce, Yt) → Ge → Zr → Pt → Ga → Tl? → (Rb, Cd) → Pb → Mo → Sn → (Nb, Ta, Ag) → Sb → (Be, Li) → (As, W) → In.

F. W. Clarke and H. S. Washington [8] have made extensive examinations of the minerals and waters, and together with the relative quantitative composition of the earth's atmosphere give a list of the elements in relative percentages of their estimated abundance. In the original, percentage figures are introduced for each division: average composition of a ten-mile crust comprising the atmosphere and hydrosphere, the average composition of a twenty-mile crust comprising the atmosphere and hydrosphere, average composition of a ten-mile crust of igneous and sedimentary rocks, average composition of ten miles of igneous rocks. The general order is as follows :—

Table XII—Earth.

O → Si → Al → Fe → Ca → Na → K → Mg → H → Ti → Cl → P → C → Mn → S → Ba → Cr → Zr → V → Sr → F → Ni → N → Ce, Yt → Cu → Li → Zn → Co → Pb → B → Be →.

In this list oxygen is about 50% and beryllium about 0.001 %, those between taking up the other 50%.

In a recent paper by Ida and W. Noddack [9], which contains a Washington-Clarke (and G. Berg) compilation, the following sequence is obtained, being for the superficial part of the earth as above.

These authors introduce an alternative modification to bring the table up to date which will be given under the table to follow here :—

Table XIII—Earth.

O → Si → Al → Fe → Ca → Na → K → Mg → H → Ti → Cl → P → C → Mn → S → Ba → Cr → N → F → Zr → Ni → Sr → V → Cu → Zn → (W, Yt) → Li → Rb → Ce → Th → Hg → Co → Nd → B → Pb → Mo → (Yb, La, Sm, Gd, Sn, Br) → As → (Be, Er) → Pr → Ar → Lu → (Tb, Tu, Ho) → Sc → Cs → Sb → Eu → Cd → I → U → (Ag, Nb) → Bi → Hg → Se → Ta → In → Ne → He → (Au, Ga) → Tl → Te → Kr → Pt → Ge → Xe → Pd → Os → Ir → Rh → Ru [Ru $= 2.3 \times 10^{-13}$]. [O $= 4.5 \times 10^{-1}$].

Zn to fall between Ni and Zr; Ga to agree with Eu; Ge, Rh, to agree with Tb; Se to fall between Tb and Sc; Ru, Pd, Pt, Os, to agree with U; In to agree closely with Cd; Te and Ir to agree closely with Ta. Ma (Eka-Manganese) and Re (Dvi-Manganese) come at the end.*

* In this connection it may be of interest to note that W. F. Meggers (*Journ. Franklin Inst.*, 1931, *211*, 273-274) has taken the arc spectrum of rhenium (Dvi-Mn) in the region from 2300 A to 8800 A, and there is one line of wave-length 4889.15 of an intensity of 2000, the next strongest line ($\lambda = 5275.57$) has a relative intensity of 1000. All the other lines are weaker. F. J. M. Stratton, in his Astronomical Physics (1925), records on page 203 the lines $\lambda = 4814.60$ and $\lambda = 4889.46$ of the star η *Carinæ* (η *Argus*) (see Moore and Sanford, *Lick.-Obs. Bull.*, 1913, *8*, 59; and Lunt, *M.N.R.A.S.*, 1919, *79*, 621). The above lines of rhenium are for the unionised atom. The line of the star may be a line from some ionised atom and therefore there is no guarantee that this close single line agreement indicates that the star is rich in rhenium; but, of course, the possibility of this being the case exists. Meggers says :— " It is esti-

It will be seen that there is general agreement in the above tables in respect of the most abundant elements; but for those less abundant there are deviations.

So many factors have to be taken into account it is surprising that any results worth recording can be obtained.

Referring to the stars there are spectroscopic difficulties owing mainly to the earth's atmosphere cutting out the ultra-violet region, which region embraces the strong part of the spectrum of certain elements. Moreover, the different ionisation potentials, or temperatures governing ionisation, as applied to the elements, so affect the lines that certain elements which are fairly abundant may not be spectroscopically detectable, or at least in some cases detectable with difficulty, and certainly not without taking into account these changes of state (see Table III). Also on the earth the more volatile elements have been so scattered, in some cases evidently, as to make it difficult to estimate the original relative quantities. Then again those elements in the far interior of the earth and also in the interior of stars are difficult to estimate. In fact, doubtful assumptions enter into these matters. Meteorites, however, afford some criterion in this respect unless some original disposition has made their composition rather different from that of the earth's interior. However, those who have made a study of the subject from many angles are able to form some opinion as expressed in the above tables.

Sir James Jeans [10] had suggested the existence of somewhat more massive atoms than those of uranium in the centre of stars, and that these atoms are the source of stellar energy, these larger atoms which sink to, or are retained in, the star's interior being super-radioactive in that their electrons and protons combine with each other *destructively*, and give rise to a high-frequency radiation that degenerates through the action of intermediate matter to ordinary stellar radiation, that is as it passes outwards through the body of the star.

H. N. Russell [7] raises an objection to this view with regard to the disposition of the more massive atoms; for, from the study of the elements in the sun's exterior—see tables above—there appears to be little evidence of the heavy elements systematically sinking to the sun's far interior, but of course the question cannot yet be answered definitely one way or the other. It is of interest, however, to note the following comments by Russell :— Referring to the elements in the sun's atmosphere, "The case of most of the heavier elements is quite different. For three of them—Os, Bi, and Ra—persistent lines lie in the accessible regions and are definitely absent from the solar spectrum. Though Ra is probably ionised, the persistent lines of Ra^{+} are also absent. There seems to be no escape, therefore, from the conclusion that these elements are present in the sun's atmosphere in negligible quantities, if at all."

Furthermore (on p. 59) Russell says :—"Two features of the distribution are conspicuous. First, it is the general downward trend towards the right [in the diagram *shown in the original*] corresponding to a diminution in the abundance with increasing atomic number. The fact is familiar; its interpretation less certain. The faintness of the lines of the heavy elements in the sun is commonly attributed to the tendency of the heavy atom to diffuse downward, below the photosphere. If this were the main explanation we should expect the heavy elements following Ba to be considerably less abundant than those which succeed Sr; but the figure shows that this is not the case and suggests a relatively rapid fall for the lighter elements from H about as far as Zr, and a very slow decrease for the heavier ones.

"Stirring of the solar atmosphere by current and other forms of turbulence favours a uniform mixture. This process occurs on an enormous scale in sun-spots, where the material must ascend from a considerable depth. The fact that, the lines La^{+} and other heavy elements, which are completely ionised even in the spots, are not perceptibly strengthened in the spot spectrum, indicates that the difference in composition is small at the depth from which the ascending vortex comes. It does not appear necessary, therefore, to assume that downward diffusion depletes the sun's atmosphere of the heavier elements, though

mated that it [Re] constitutes about one part in a million million of the earth's crust," which reduced to a decimal fraction is 10^{-12}. See in this connection Loring, The Optical Spectrum of Rhenium (Dvi-Mn) and Attempts to Identify this Element in the Stars, *Chemical News*, 1931, *142*, 321-322. It appears to exist in the sun.

the possibility of such an influence remains." In this connection should be noted a paper on the elements undiscovered or doubtful in the sun by C. E. St. John [11].

It is in respect of these matters that the present study may be suggestive in throwing some light on the subject. For example, since the alkali metals are physically similar the scheme of Table XV enables a coordination to be made with a possible extrapolation for eka-cæsium of atomic number 87, the existence of which is doubtful.

TABLE XV.

Prob. No.	Element in order of abundance and its resistivity.
3	Na = 4.5 × 10^{-6}
7	K = 6.8 × 10^{-6}
9	Li = 9.2 × 10^{-6}
13	Rb = 12.9 × 10^{-6}
21	Cs = 20.5 × 10^{-6}
45	87? = 45 × 10^{-6}?

Comparing this table with Table II seems to suggest that the probability numbers are not mutually exclusive as applied to different sets of elements. Those of Group I, above, have just as much right to follow these numbers as those of Table II, which for the most part (except for Bi) are of Groups II, IV and VIII. This is perhaps unsatisfactory in one way, but the findings must be recorded as found. At any rate, there appears to be a marked tendency for the values to be distributed so as to strengthen the probability feature as represented by numbers. Interpretation by number thus affords one criterion, but unfortunately the classification, as given by Fig 1, is of necessity incomplete, so that one can only record and classify the values so far found and hope for the best.

There is a feature to be noted in closing this section. In judging the abundance of a given element by the intensity of its spectrum lines, one should bear in mind (1) the favourable condition for exciting the lines, and (2) that some elements give more strong lines in the available region than others.

(To be continued.)

FEDERATED MALAY STATES IMPORTS OF FORMIC ACID.

Imports of Formic Acid into the Federated Malay States during the fourth quarter of 1930 totalled 184 tons as compared with 201 tons in the corresponding period of 1929.

THE COLLINSICS OF MINERALS. XX.

By HAWKSWORTH COLLINS, B.A.Camb.

The eleven collinsics given in Table XLVII introduce ferrous iron of which the voloptic is R.V.11.64 and O.R.10.08. Ferric iron (voloptic R.V.10.08 and O.R.19.58) was brought in previously and has appeared 28 times up-to-date.

It is a peculiar fact that the Optical Refractivity of ferrous is identical with the Relative Volume of ferric iron; *i.e.*, an O.R. of an element is equal to an R.V. of the same element. This might be considered to be accidental, if it were not also a fact that in the 30 elements so far brought into the collinsics there are several such cases. All these pecularities are placed together in Table XLVI.

TABLE XLVI.

	R.V.	O.R.
B	3.865	3.865
Ca	13.25	13.25
N	3.8	3.8
Sr	19.56	19.56
Cr	21.73	21.73
I	27.75	27.75
V	17.76	17.76
Ni	11.53	11.53
Br	18.05	18.05
S	15.53	15.53
Cu	9.54	14.77
K	22.29	7.49
Mn	13.02	11.53
Mn	11.53	13.02
P	14.56	10.51
Se	21.29	17.43
Zr	15.59	21.59
Fe	10.08	19.58
Fe	11.64	10.08
Si	13.02	11.53

This matter concerns 18 of the 30 elements which have at present been considered in the collinsics. All these R.V.s and O.R.s have been demonstrated to be relative volumes of the several elements in the *Chemical News* from the year 1923 either when the structure of each element was being discussed, or when the Law of Heat of Formation was being demonstrated. 7.49 has only been obtained as a volume of K when forming a part of other elements. These volumes are, of course, all calculated at the same temperature, 15° C.

The most important points to notice with regard to these 20 coincidences are:

That there are only five instances, *a*, *b*, *c*, *d*, *e*, in the first 247 collinsics in

which the R.V. or O.R. of an element is equal to the R.V. or O.R. of *another* element. This fact places the 20 cases in Table XLVI far out of the region of chance; *i.e.*, it contains a truth. When the cause of this truth is found, of course it will throw a great light upon the structure of the elements.

(*a*) The O.R. of sodium is equal to both the R.V. and O.R. of boron. The reason for this has lately been shown in the *Chemical News, viz.*, that sodium equals boron plus carbon.

(*b*) The R.V. and O.R. (13.02) of Mn equals a R.V. of Si. The reason for this has previously been shown to be that Mn=SiAl, the Al-portion of this element being absorbed entirely by the Si-portion.

(*c*) The R.V. and O.R. 11.53 of Mn equals an O.R. of Si.

(*d*) The R.V. and O.R. of Ni equals the O.R. of Si. The structure of Ni was found to be Si+P, *Chemical News*, 1927, CXXXIV 81.

(*e*) The R.V. of As equals the O.R. of Fe.

The last is probably the only accident in all the 25 cases. The full list of voloptics up-to-date was given in the preceding paper.

2. Nearly all these figures have rational explanations; *e.g.*,

Atomic weights :—V(51)=Mg(24)+Al(27).
R.V. and O.R. :—V(17.76)= Mg(8.71)+Al(9.05).
Atomic weights :—Cr(52)=Mg(24)+Si(28).
R.V. and O.R. :—Cr(21.73)= Mg(8.71)+Si(13.02).

But there is no room here to go further into all these matters again.

TABLE XLVII.

ELEVEN COLLINSICS CONTAINING FERROUS IRON.

(237) Ilvaite $CaHFe_2''Fe'''Si_2O_9$

Theor. S.G. **4.05** Obs. S.G. 3.99 D 4.1 W

$Ca \quad H \quad Fe_2 \quad Fe \quad Si_2 \quad O_9$

$\mathbf{90.7788=0.8988(13.25+5.76+11.64_2+10.08+13.02_2+2.51_9)}$

Theor. R.I. **1.8988** Obs. R.I. N_m 1.89 N_g 1.91 W

$\mathbf{90.777=13.25+2.613+10.08_2+19.58+11.53_2+1.346_9}$

(238) Hedenbergite $CaFeSi_2O_6$

Theor. S.G. **3.566** Obs. S.G. 3.55 W 3.58 D

$Ca \quad Fe \quad Si_2 \quad O \quad O_5$

$\mathbf{51.363=0.7385(13.25+11.64+13.83_2+4.45+2.51_5)}$

Theor. R.I. **1.7385** Obs. R.I. N_m 1.7366 W N_g 1.7506 W

$\mathbf{51.367=13.25+10.08+9.78_2++1.747+1.346_5}$

(239) Vauxite $FeAl_2P_2O_9.6H_2O$

Theor. S.G. **2.361** Obs. S.G. 2.37 W

$Fe \quad Al_2 \quad P_2 \quad O_2 \quad O_2 \quad O_5 \quad Aq_6$

$\mathbf{99.794=0.5558(11.64+9.05_2+14.56_2+7.53_2+4.45_2+2.51_5+14.03_6)}$

Theor. R.I. **1.5558** Obs. R.I. N_m 1.555 W

$\mathbf{99.794=10.08+7.865_2+10.51_2+1.654_2+1.747_2+1.346_5+6.572_6}$

(240) Ammonium iron selenate $Am_2FeSe_2O_8.6H_2O$

Theor. S.G. **2.168** Obs. S.G. 2.16 Topsoe

$Am_2 \quad Fe \quad Se_2 \quad O_3 \quad O \quad O_4 \quad Aq_6$

$\mathbf{116.085=0.52005(23.87_2+11.64+21.29_2+7.53_3+4.45+2.51_4+14.03_6)}$

Theor. R.I. **1.52005** Obs. RI. 1.5201 CRPC.

$\mathbf{116.085=9.81_2+10.08+17.43_2+1.654_3+1.747+1.346_4+6.572_6}$

(241) Ferrous sulphate $FeSO_4.7H_2O$

Theor. S.G. **1.91** Obs. S.G. 1.904 Filhol

$Fe \quad S \quad O_2 \quad O_2 \quad Aq_7$

$\mathbf{67.83=0.4663(11.64+15.53+7.53_2+2.51_2+14.03_7)}$

Theor. R.I. **1.4663** Obs. R.I. 1.4713 C.R.P.C

$\mathbf{67.834=10.08+5.75+1.654_2+1.346_2+6.572_7}$

(242) Chloritoid $H_2FeAl_2SiO_7$

Theor. S.G. **3.51** Obs. S.G. 3.52 D

H_2 Fe Al_2 Si O_7

$\mathbf{51.983 = 0.7235(5.76_2 + 11.64 + 9.05_2 + 13.02 + 2.51_7)}$

Theor. R.I. **1.7235** Obs. R.I. 1.72 M

$\mathbf{51.988 = 2.613_2 + 10.08 + 7.865_2 + 11.53 + 1.346_7}$

(243) Cronstedtite $H_4Fe_2''Fe_2'''SiO_9$

Theor. S.G. **3.422** Obs. S.G. 3.34-3.445 D

H_4 Fe_2 Fe_2 Si O O_2 O_6

$\mathbf{93.457 = 0.7996(5.76_4 + 11.64_2 + 10.08_2 + 18.91 + 7.53 + 4.45_2 + 2.51_6)}$

Theor. R.I. **1.7996** Obs. R.I. N_m 1.80 ± W

$\mathbf{93.457 = 2.613_4 + 10.08_2 + 19.58_2 + 10.461 + 1.654 + 1.747_2 + 1.346_6}$

(244) Glaucophane $NaFeAlSi_3O_9$

Theor. S.G. **3.09** Obs. S.G. 3.091 D

Na Fe Al Si_3 O_2 O_2 O_5

$\mathbf{69.935 = 0.6468(11.865 + 11.64 + 9.05 + 13.02_3 + 7.53_2 + 4.45_2 + 2.51_5)}$

Theor. R.I. **1.6468** Obs. R.I. 1.6442 D

$\mathbf{69.932 = 3.865 + 10.08 + 7.865 + 11.53_3 + 1.654_2 + 1.747_2 + 1.346_5}$

(245) Staurolite $Fe_2Al_{10}Si_4O_{25}.H_2O$

Theor. S.G. **3.650** Obs. S.G. 3.65

Fe_2 Al_{10} Si_4 O O O_{23} Aq

$\mathbf{185.852 = 0.7446(11.64_2 + 9.05_{10} + 13.02_4 + 7.53 + 4.45 + 2.51_{23} + 14.03)}$

Theor. R.I. **1.7446** Obs. R.I. 1.736-1.746 D

$\mathbf{185.861 = 10.08_2 + 7.865_{10} + 11.53_4 + 1.654 + 1.747 + 1.346_{23} + 6.572}$

(246) Daphnite $H_4Fe_2Al_2SiO_9$

Theor. S.G. **3.01** Obs. S.G. 3.0 W

H_4 Fe_2 Al_2 Si O_7 O_2

$\mathbf{72.79 = 0.6407(5.76_4 + 11.64_2 + 9.05_2 + 13.02 + 4.45_7 + 2.51_2)}$

Theor. R.I. **1.6407** Obs. R.I. N_m 1.64-1.66 W

$\mathbf{72.793 = 2.613_4 + 10.08_2 + 7.865_2 + 11.53 + 1.747_7 + 1.346_2}$

(247) Ammonium iron sulphate $AmFeS_2O_8.6H_2O$

Theor. S.G. **1.825** Obs. S.G. 1.848 P & J. 1.813 Schiff

Am_2 Fe S S O_4 O_4 Aq_6

$\mathbf{102.45 = 0.477(23.87_2 + 11.64 + 15.53 + 15.53 + 7.53_4 + 2.51_4 + 14.03_6)}$

Theor. R.I. **1.477** Obs. R.I. 1.490 CRPC

$\mathbf{102.412 = 9.81_2 + 10.08 + 5.75 + 15.53 + 1.654_4 + 1.346_4 + 6.572_6}$

Method of Discovery of the Collinsic of Ilvaite.

Divide the molecular weight (409) by the approximate specific gravity (4.0) obtaining about 102. Multiply this by 0.9 (μ-1 approx.) and the product is 91.8. It is therefore settled by the experimental data that the molecular volume must be about 102 and the optical refractivity about 92.

As the three O.R.s of oxygen do not differ much, and since the smallest value is three times more common than the other two together, we will take all the oxygen atoms to have the lowest voloptic as a first approximation. The voloptic of hydroxyl is always 5.76, 2.613, and that of ferric iron 10.08, 19.58; and from the remaining ten collinsics in Table XLVII ferrous iron has the voloptic 11.64, 10.08.

Adding these, the results are as follows :

R.V.	O.R.
22.59 = 9 × 2.51	12.114 = 9 × 1.346
5.76	2.613
10.08	19.58
23.28 = 2 × 11.64	20.16 = 2 × 10.08
61.71	54.467

Subtracting 61.71 from 102, and 54.467 from 91.8 the remainders are 40.29 and 37.333. These two numbers must represent the sum of the voloptics of Ca and 2Si approximately; otherwise the collinsic of Ilvaite cannot be found.

There are three voloptics of Ca, *viz.*, 14.54, 1 0.52; 13.25, 13.25; and 12.24 15.6885; and there are four voloptics of Si, 18.91, 10.461; 17.61, 9.625; 13.83, 9.78 and 13.02, 11.53. The only possible combination to suit the present case is $13.25+13.02_2=39.29$, and $13.25+11.53_2=36.31$. Adding these to the above we obtain :—

R.V.	O.R.
61.71	54.467
39.29	36.31
101.00	90.777

As these values are near to the approximate ones obtained above we will now begin again. Dividing the mol.wt. 409 by 101 the result is 4.05, which is the mean of the two experimental values of S.G., and multiplying 101 by 0.8988 the result is 90.7788 which is identical to four figures with 90.777; so that the theoretical R.I. is 1.8988 which differs by about 1 in 200 from the mean value found experimentally by Winchell, and lies between the mean and the greatest experimental values.

There is no other solution to the problem, and there is no possibility of any of the higher values of oxygen being present, for they would produce an immense lowering of the S.G.

All other collinsics have been obtained in a similar manner, and there is never any doubt about the truth of them, except when the experimental values are doubtful.

There are several other reasons, *a*, *b*, *c*, *d*, *e*, why the results obtained are correct :

(*a*) If one atom of Si in any particular substance has the voloptic 13.02, 11.53, it it a general rule that all the atoms of Si have the same voloptic, and similarly for all elements which have more than one voloptic. *E.g.*, in number 245 all four Si-atoms have the same voloptic, and all ten Al-atoms also have the same. There are only 12 exceptions to this general state of affairs in the first 247 collinsics.

(*b*) Si has already appeared 61 times in 103 minerals with none of the higher voloptics of oxygen; so that, if in the future any substance containing Si is found to have none of the higher values of oxygen present, this is an additional reason for the certainty of the truth of its collinsic; for it is in accordance with a common state of affairs.

(*c*) Si has already appeared 57 times in 103 minerals with one higher voloptic of oxygen to each atom, so that, if in the future any substance is found to have as many higher voloptics of oxygen as there are Si-atoms present, this is an additional reason for the certainty of the truth of the collinsic, for it is in accordance with a common state of affairs.

(*d*) Se has only appeared six times in the collinsics at present, and each time there are two higher oxygen voloptics preseut, so that, if in the future, etc.

(*e*) S has appeared 21 times with two of the highest voloptics of oxygen in the 32 substances containing this element; so that, if in the future, etc.

No. 246, Daphnite, is purposely inserted here in order to draw attention to the large number of variations that are possible in the combinations of the three voloptics of oxygen. Here there are seven atoms of oxygen of volume 4.45 and only two of 2.51. This is quite unusual, but it emphasises the significance of the observations, *b*, *c*, *d* and *e*. There is no other solution to the problem concerning daphnite; but the fact that there is just one solution and no other makes it practically certain that the truth has been obtained although it is unusual.

AMERICAN HONOUR FOR SIR JAMES H. JEANS, F.R.S.

From advices received from the Franklin Institute of the State of Pennsylvania we are able to inform our readers that on Medal Day, 20 May, Sir James H. Jeans was presented with the Franklin Medal and Certificate of Honorary Membership of the Institute After the presentation, Sir James read a paper " The Origin of the Solar System."

The Franklin Medal (Gold Medal).—This medal is awarded annually from the Franklin Medal Fund, founded January 1, 1914, by Samuel Insull, Esq., to those workers in physical science or technology, without regard to country, whose efforts, in the opinion of the Institute, acting through its Committee on Scienee and the Arts, have done most to advance a knowledge of physical science or its applications.

JAMES CLERK MAXWELL CENTENARY CELEBRATIONS AT CAMBRIDGE.

The provisional programme of the celebrations to be held in honour of Clerk Maxwell on October 1 and 2 has recently been circulated by the Vice-Chancellor.

The committee appointed by the Council to make arrangements for the celebration have issued invitations to 87 universities, academies, and other corporate bodies, inviting them to appoint delegates to the celebration, and over 88 delegates have now been appointed. Personal invitations have also been issued to a number of physicists of distinction and others. The programme includes a memorial lecture by the Master of Trinity College; addresses by Professor Planck, Professor Sir Joseph Larmor, Professor Langevin, and Sir James Jeans; receptions, a luncheon, conversaziones in the Cavendish Laboratory, an at home by the new Vice-Chancellor and Mrs. Spens, and a dinner at Trinity College.

The after glow of James Clerk Maxwell's reputation has illumined many a young investigators thoughts, and lead him upwards.

Maxwell like many other benefactors of the human race was never really accorded during his lifetime, short as it was, the credit that was his due. As a boy he was brilliant without evidence of precocity and his very early contributions to science commenced with a schoolboy paper on oval curves. In 1865 he reached the summit of his endeavours by the publication of his elaborate work, which Sir Oliver Lodge in a recent article in the "Sunday Times" has restated in the light in modern thought namely, thus :—"Light is an electro-magnetic phenomenon, generated by the interaction and co-existence of two oscillating fields—one electric, the other magnetic."

Hertz and Marconi followed upon Maxwell's doctrine and only then did the public give ear.

Maxwell achieved work of the utmost brilliance, equal to any that is being done now. Upon his theses or shall we say, doctrines, other men, have built. They have received the acclamation of the crowd. Why? Because in the days of Maxwell "there were none so poor as would do him reverence." Only the small body of scientists knew of Maxwell and his work and the Press did not in any way, take him up, consequently the general public heard little or nothing of his great work for humanity. Yet, when the practical expositions of his doctrine began to publicly experiment, the Press sent its representatives to the furthermost parts of the world. Why? Because the subject had begun to assume an application to ordinary life. Safety of life at sea became the subject of popular thought and discussion—and only because Hertz, Marconi and their co-workers had followed where earlier Maxwell had led. Because the public had not been educated to receive the doctrine and theories of Maxwell, his (shall we say) disciples were heralded as discoverers of miraculous things; instead of which their work was merely the natural sequence and development of all that had gone before.

Let the words of Sir Oliver Lodge carry greater weight than mine.

"It may be said that every discovery can be traced back to its scientific ancestry. We are all standing on the shoulders of our predecessors and building on the information which they have brought out by diligent study. But a few landmarks or salients stand out vividly in the long course of evolution, and the most brilliant of those lighthouses, in my experience, is the one lit by Clerk Maxwell in the year 1865."

H.W.B.R.

HEADMASTER OF ALLHALLOWS SCHOOL, HONITON.

The Trustees of Allhallows School, Honiton, have appointed Mr. Dennis Brook Briggs, M.A., F.I.C., F.G.S., at present a housemaster at Bradfield College, to the headmastership vacant by the resignation of Mr. F. J. Middlemist, after having held the office for 30 years. Mr. Briggs was a scholar of Jesus College, Cambridge, where he took a First Class in the Natural Science Tripos.

Mr. Brook Briggs is well known to our readers being the author of several important books on chemistry.

VACATION COURSES AT HALLE IN GERMANY.

The Anglo-German Academic Bureau have arranged with the University Authorities in Halle for courses of instruction to be given in English at the University from August 10 to 25.

Information concerning the syllabus of lectures, fees, accomodation, etc., may be obtained from Mr. E. C. Cook, Bletchley Bucks.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

June 18, 1931.

The following papers were read in title only :—

The Chromosome Constitution of the Pomoideae. By A. A. Moffett. Communicated by Sir Daniel Hall, F.R.S.

Contributions to the knowledge of Lower Carboniferous Plants, III. By J. Walton. Communicated by F. O. Bower, F.R.S.

The Integration of Plant Behaviour, III. By Sir Frederick Keeble, F.R.S., M. G. Nelson and R. Snow.

The Reaction of Living Tissues to Homogeneous X-Radition produced by Crystal Diffraction. By W. Moppett. Communicated by J. T. Wilson, F.R.S.

Experiments on the Physiology and Genetics of the Smut Fungi. Cultural Characters, III. By S. Dickinson. Communicated by E. J. Butler, F.R.S.

The Development of Various Strains of Leishmania in Chinese Sandflies. By E. Hindle. Communicated by H. H. Dale, Sec.R.S.

Nitrite formation by soil bacteria, other than Nitrosomonas. By D. Ward Cutler and B. K. Mukerji. Communicated by Sir John Russell, F.R.S.

A Crystalline Antirachitic Substance. By T. C. Angus, F. A. Askew, R. B. Bourdillon, H. M. Bruce, R. K. Callow, C. Fischman, J. St. L. Philpot and T. A. Webster. Communicated by H. H. Dale, Sec.R.S.

The Potential Difference across the Surface bounding the Unfertilised Egg of the Brown Trout. By R. J. Pumhrey. Communicated by J. Gray, F.R.S.

Investigations on Mediterranean Kala-Azar. By S. Adler and O. Theodor. Communicated by H. H. Dale, Sec.R.S.

The Heat Tension Ratio in Prolonged Tetanic Contraction. By T. P. Feng. Communicated by A. V. Hill, F.R.S.

The Oxygen Uptake of Frozen and Thawed Muscles. By E. C. Smith. Communicated by Sir William Hardy, F.R.S.

The Breakdown and Re-synthesis of Phosphagen in Frozen and Thawed Muscles. By E. Kreps. Communicated by Sir William Hardy, F.R.S.

ROYAL AGRICULTURAL SOCIETY.

June 3.

Sir Arthur Hazelrigg, Bart. (President), in the Chair.

At the chemical committee meeting, Mr. Fred Smith (Chairman) reported that the Consulting Chemist (Dr. Voelcker) had informed them of the ultimate settlement of two cases in which members of the Society had experienced loss or depreciation of stock through the feeding, to animals, of linseed cake which he (Dr. Voelcker) had found to contain castor-oil bean. These cases were reported in the minutes of Council, February 5, 1930, and the question of liability had, in the meantime, been before the Courts and decided. Consequent on this decision, compensation had now been given to the members in question, the one receiving £594 17s. 6d. and the other £75 in respect of the losses incurred.

With these and other striking examples, brought from time to time before the notice of the Chemical Committee, as testifying to the great risk run by feeding to stock anything that contains castor-oil bean, even in apparently small amounts, it is distinctly unfortunate that in a Bulletin (No. 11, Oil Cakes and Extracted Meals) recently issued by the Ministry of Agriculture the incorrect and misleading statement should be made that castor-oil-seed cake (*i.e.*, cake composed entirely of castor-seed) should not be used for feeding unless it has first been "submitted to the action of heat."

The only way of ensuring safety is to insist rigidly on the entire exclusion from feeding stuffs of anything possessed of poisonous properties, as is the case with castor-oil bean. The Committee had, accordingly, thought it well to address a letter to the Ministry on the subject, and ask the Council's sanction to its going forward.

Dr. Voelcker had also reported upon a sample sent to him as "Oat Meal" and costing £4 10s. per ton delivered. On further enquiry it was ascertained to have been sold as "Oat Feed," but no analysis nor guarantee had been given with it.

It was found to consist of, approximately, one-half ground oats and the other half oat husks. The analysis showed 20 per cent. of fibre with 5½ per cent. of siliceous matter, and the price asked was much beyond the value. Genuine ground oats would contain about 10 per cent. of fibre and from 1 to 1½ per cent. of siliceous matter. Fur-

there under the Fertilisers and Feeding Stuffs Act, not only should a guaranteed analysis have been given, but also (Third Schedule) a declaration as to the presence of oat *husks*.

Mr. Fred Smith, in presenting this report, wished to draw attention to the fact that deliveries of manures and feeding stuffs had very much improved during recent years. There was not so much adulteration, and the bulk was more often up to the standard laid down by the analysts. The Committee were doing a good work for some of the members, as they had obtained no less than £594 17s. 6d. and £75 for breeders of stock who had unfortunately used linseed cake containing castor bean. He therefore thought that the Committee was justified in bringing the fact to the noice of the Minister of Agriculture that it was very dangerous to feed castor bean, and ought to be avoided.

MINEROLOGICAL SOCIETY.

June 9.

Sir John S Flett, President, in the chair.

On an Occurrence of Vanadiferous Nodules on the Coast of South Devon. By G. E. L. CARTER.

The author describes an occurrence of vanadiferous nodules in the red marls that underlie the Budleigh Salterton pebble beds on the coast of South Devon. These nodules consist of siliceous and argillaceous material impregnated with vanadium oxide and calcium carbonate. A typical nodule examined at the Imperial Institute showed a roughly concentric structure, ill-defined black shells alternating with shells of light-coloured material. Radiating black bands stood out as ribs on the surface of the nodule. Analyses by Miss Hilda Bennett showed that the black portion of the nodule contained 13.96 per cent. of vanadium oxide, estimated as pentoxide. The light-coloured portion of the nodule contained only 1.91 per cent. of vanadium oxide, and was relatively richer in calcareous and siliceous matter than the blacker and more vanadiferous portion. The occurrence deserves investigation from the economic point of view, as vanadium minerals are of sparse distribution. A preliminary optical and X-ray examination by F. A. Bannister of the darker material of the nodules suggests the presence of a vanadiferous chlorite.

Studies on the Zeolites. Part II. Thomsonite (including faroelite) and Gonnardite. By MAX H. HEY.

An analytical, optical and X-ray study of a considerable number of thomsonite speciments has led to the conclusion that thomsonite and faroelite form a continuous isomorphous series. The true symmetry of thomsonite is shown to be didigonal polar (C_{2v}). The unit cell is shown to contain $(Ca, Na)_6\ (Al)Si_{20}O_{40}.12H_2O$. The mean refractive index ranges from 1.517 to 5.535, falling with increase in the Si/Al ratio. Apparatus has been designed and applied to measure the vapour pressure of thomsonite at various temperatures and degrees of dehydration, and it appears very probable that a dimorphous high-temperature form exists, the transition being readily reversible. Connardite is probably identical with the high temperature dimorphous form of thomsonite (meta-thomsonite) and is therefore to be regarded as a separate species.

An account of British Mineral Collectors and Dealers in the 17th, 18th and 19th centuries. A second instalment :—John Woodward (1665-1728), and Charles Francis Greville (1749-1809). By ARTHUR RUSSELL.

Hoba (South-West Africa), the largest known Meteorite. By Dr. L. J. SPENCER.

The large mass of meteoric iron discovered in 1920 on Hoba West farm, 12 miles west of Grootfontein measures about 10 x 9 feet on its uat upper surface, and is estimated to weight 60 metric tons. It belongs to the group of nickel-rich ataxiates. Chemical analysis by Mr. M. H. Hey shows Fe 83.84, Ni 16.24 per cent., with small amounts of cobalt, copper, sulphur, phosphorus, and carbon. Photomicrographs (x 820) by Dr. J. M. Robertson show a minute plessite-like structure.

Twelfth List of New Mineral Names. By Dr. L. J. SPENCER.

Since the publication in 1928 of the eleventh list of this series (the first was in 1897) 120 names have been collected from the current literature. In addition to the bibliographical reference, a brief description of the essential characters of the mineral and derivation of the name are given.

On Different Habits of Fluorite Crystals. By Dr. J. DRUGMAN.

In fluorite the cube is usually the predominating form. Crystals of other habits —octahedral, rhombic-dodecahedral, and triakis-octahedral—are described. The temperature during the growth of the crystals has perhaps influenced its habits .

CHEMICAL SOCIETY OF JAPAN.

April 7, 1931.

The following papers were read :—

X-Ray Studies on the Ferrites. By YOGORO KATO, TAKESHI TAKEI and TARO MATSUHASHI.

Effect of Strain on the Formation of the Cupric Oxide-Film. By YOGORO KATO and NAGAO HAYAMI.

Physico-Chemical Study on the System of Linalool-Camphor. By KICHIMATSU MATSUNO, YOSHIO KITANO and KICHIRO AMIYA.

Physico-Chemical Study on the System of Aquocobaltammine Organic Amines. By YOSHIO KITANO and YOKEI ISHIGAKI.

On the Preliminary Report for the New Method of Quantitative Analysis. By SAICHIRO NAGAMI and TAKIO KATO.

Quantitative Chemical Analysis by the Secondary X-Ray. By YOSHIO NISHINA and SANAE YOSHIDA.

Diffusion of Zinc into Copper (II). By YOSHITO YAMAUCHI.

Studies on the Chemical Affinity. By FUSAO ISHIKAWA.

On the Rate of Solution of Oxygen into Water. V. By SUSUMU MIYAMOTO and AKIRA NAKATA.

On the Rate of Solution of Oxygen into Water. VI. By SUSUMU MIYAMOTO and TETSUO KAYA.

A Theory of the Rates of Solution of Gases into Liquids. By SUSUMU MIYAMOTO.

Thermodynamical Study on Lithium Chloride and Lithium Hydroxide. By YUJI UEDA.

On the Decomposition of Nitrogen Pentoxide. By WASABURO JONO.

The Velocity of the Reaction between NO and O_2 at low Temperatures. By REMPEI GOTO.

On the Decomposition of CO in the Presence of Reduced Nickel. By TAIKEI RI.

Photochemical Synthesis of Phosgen. By TEIJI ICHIKAWA.

Thermal Analysis of Chemical Reaction. A Simple Calorimeter. By SHINKICKI HORIBA BABA.

Permeability of Transparent Silica Glass to Hydrogen at high temperatures. By TAKEO WATASE.

On the Permeable Layers to Fluids. By MASUO KAWAKAMI.

On the Solubilities of some Difficultly Soluble Gases. By JURO HORIUCHI.

Effect of Air on the Physical Properties of Organic Solvents. By JURO HORIUCHI.

NOTICES OF BOOKS.

Die Polysaccharide. By HANS PRINGSHEIM. Third, enlarged edition. Pp. x+393. Berlin : Julius Springer. 1931. Price 25 marks.

Since the publication of the second edition of Prof. Pringsheim's standard treatise on the polysaccharides in 1923 the subject has been one of the most investigated fields of organic chemistry. Many researches have been made to elucidate the structure of starch, cellulose and other carbohydrates. There have also been much technical and industrial work done upon these compounds.

In Prof. Pringsheim's book the polysaccharides are classified into first and second orders. The former include the trehalose, maltose, amylose and anhydrose types. The complex polysaccharides include cellulose, starch, glycogen and inulin. The chief interest in the simpler substances lies in the attempts to synthesis these bodies by chemical and by biological means. The peculiar properties and reaction of cellulose still cause its study to be full of perplexities and remarkable results. Recently many new esters and ethers of the complex carbohydrate have been reported but Prof. Pringsheim has preferred to postpone a discussion of their significance.

He has, however, devoted considerable space to starch in its various forms and he refers also to the pectins and chitin. The vexed question of starch diodide seems no nearer a satisfactory explanation.

With regard to the constitution of the complex polysaccharides, the various methods of approach are described. The very nature of these bodies makes such means as molecular weight determination of little value and special methods have been resorted to. (These the author has described in detail. The two formulae put forward last year by Meyer and Mark and by Haworth probably are not to be accepted as other than provisonal and the same applies to Pictet's formula for starch.

For those interested in the chemistry of the carbohydrates Prof. Pringsheim's book is indispensable.

Forthcoming Events.

SOCIETY OF CHEMICAL INDUSTRY.
MONDAY, JULY 13, TO SUNDAY, JULY 19.

Jubilee Celebrations and Fiftieth Annual Meeting. Headquarters, Great Central Hotel, Marylebone, London, N.W.1. MONDAY, JULY 13. 11.30 a.m. Opening of Chemical Plant and Research Instruments Exhibition by the President. 1 p.m. Luncheon, Hotel Victoria, W.C.1. Tickets 6s. 6d. 3 p.m. Reception by Lord Mayor and Sheriffs at Guildhall, E.C. 8.15 p.m. Reception by the President and Lady McGowan, Great Central Hotel, N.W. 9 p.m. Musical entertainment. TUESDAY, JULY 14. 10 a.m. Council meeting. 10.30 a.m. Annual General Meeting, Royal Academy of Music, Marylebone, N.W. 12.45 p.m. Luncheon, Great Central Hotel. 2.10 p.m. Start for Garden Party, Lensbury Club, Teddington. 5.30 p.m. Reception of Original Members, Girdlers' Hall, E.C. 7 p.m. Reception and meeting by the Master of the Salters' Company, Salters' Hall, E.C. "Recent Developments of the Society of Chemical Industry in Basle," by Dr. G. Engi. Also address by Dr. Henrich Schicht. 9 p.m. Lecture by Prof. R. V. Wheeler on "Dust Explosions," Home Office Industrial Museum, Westminster, S.W. 10 p.m. Visit to printing works of *Daily Mail*. WEDNESDAY, JULY 15. 10.30 a.m. Presentation of the Society's Medal to Dr. Herbert Levinstein, followed by an Address by the Medallist at Royal Academy of Music, Marylebone Road, N.W.1. 10.30 a.m. Tour by coach through London. 2 p.m. Works visits:—Wallpaper Manufacturing Co., Ltd. (A. Sanderson and Sons, Perivale); General Electric Research Laboratories at Wembley; Achille Serre, Ltd., Walthamstow; British Drug Houses, Ltd., Graham Street, E.C.; South Metropolitan Gas Co., East Greenwich; Mortlake Brewery of Watney, Combe, Reid and Co., Ltd. 7.30 p.m. Annual Dinner, Great Central Hotel. Limited to 600 Members of the Society. No lady guests. 6.30 p.m. Dinner for ladies at Madame Tussaud's, followed by visit to cinema. THURSDAY, JULY 16. 9.30 a.m. All-day visit to Agricultural Research Station, Rothamsted. 10.30 a.m. Addresses will be given in Leathersellers' Hall, E.C. 10.30 a.m. Meeting for reading and discussing papers presented by overseas Members, Regent Room, Great Central Hotel. 10.30 a.m. Meeting for discussing papers published in the Journal of July 3, Marylebone Room, Great Central Hotel. 10.45 a.m. Tour by coach through London. 12.30 p.m. Luncheon, Trocadero Restaurant, W., followed by visit to J. Lyons and Co., Ltd., Cadby Hall, W., and Greenford factory. 2 p.m. Works visit:—National Physical Laboratory and Chemical Research Laboratory, Teddington; The Distillers Co., Ltd.; Burroughs Wellcome and Co., Dartford; Pyrene Co., Brentford and Firestone Tyre and Rubber Co., Brentford; Fuel Research station, Greenwich. 8.30 p.m. Reception by the President and Lady McGowan, Savoy Hotel, W.C. FRIDAY, JULY 17. All-day excursions:—9.15 a.m. Huntley and Palmer's Biscuit Factory, Reading; 9 a.m. Research Station of Anglo-Persian Oil Co., Sunbury-on-Thames; 9 a.m. Windsor Castle, Eton College, and then by river to Bourne End. 8.30 p.m. Reception and Dance, Imperial Chemical House, Millbank, S.W. SATURDAY, JULY 18. 9 a.m. All-day excursion to Oxford. SUNDAY, JULY 19. 10.30 a.m. Service, at St. Paul's Cathredral. 2.30 p.m. Visit Hampton Court. 3 p.m. Visit to the Zoo.

BRITISH CHEMICAL PLANT EXHIBITION.

CENTRAL HALL, WESTMINSTER, S.W.
July 13—18.

This exhibition, organised under the auspices of The British Chemical Plant Manufacturers Association of 199, Piccadily, W.1., was designedly arranged to concide with the Society of Chemical Industry's Jubilee Celebrations, and no more fitting time could obviously have been chosen, when all who matter in the Industry are congregating in the metropolis.

Manufacturers of scientific instruments, research materials, general chemical engineering plant and the old established general engineers, such as Babcock and Wilcox, all are contributing their quota in an endeavour to force the pace for a reutrn to increased prosperity.

The B.C.P.M.A. have supplied us with much useful literature concerning the exhibits and we would advise those of our readers who are interested in the industrial application of Chemistry, to visit the Exhibition. Any information required prior to the Exhibition will be readily given at the offices of the B.C.P.M.A., 199, Piccadily, W.1.

INTERNATIONAL CONFERENCE OF BENZOLE PRODUCERS.

Hamburg was the venue of many important members of the Benzole Industry when the Fourth plenary meeting of The International Conference of Benzole Producers took place on Friday, June 12. Great Britain and Continental countries were represented and the delegates from England were headed by Sir David Milne Watson, LL.D., D.L., President of The National Benzole Association.

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New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

16,170.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of amides of higher fatty acids. June 4.

16,477.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of condensation products. June 5.

16,577, 16,578.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of anthraquinone derivatives. June 6.

Specifications Published.

349,472.—Metallges. Akt.-Ges. — Eliminating arsenic from acids, particularly sulphuric acid.

349,677.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of derivatives of meta-hydroxy-diphenylamine.

Abstract Published.

344,796.—Alcohols; formaldehyde.—Park, J. R., Norton Hall, The Green, Norton-on-Tees, and Imperial Chemical Industries, Ltd., Millbank, London.

Iron compounds present in synthetic alcohols prepared by the catalytic hydrogenation of oxides of carbon under pressure are removed by subjecting the impure alcohols to prolonged treatment with alkali, with or without stirring, at ordinary or raised temperatures. Advantageously the liquid is aerated either at the commencement of or throughout the treatment. In an example, crude synthetic methanol is allowed to flow over solid caustic soda and then into a steel tank. A slow stream of air is passed while the tank is filling after which the mixture is allowed to stand for 5 days and is then distilled. In the manufacture of formaldehyde by passing methanol vapour mixed with air over red hot silver gauze, the purification of the methanol by the above process prevents the rapid deterioration of the catalyst which results when crude methanol is employed.

The Latest TRADE MARKS

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GLUMIN.

522,399.—Chemical substances in class 1 for use in the treatment of textile fabrics and leather in the course of their manufacture.—H. Th. Bohme Aktiengesellschaft, 29, Moritzstrasse, Chemnitz, Germany. June 10.

ANTIBACSYN.

522,462.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Antibody Products, Ltd., 57, Bushey Grove Road, Watford, Hertfordshire. June 10. (Associated.)